

MAINTENANCE MANUAL



MODEL
PD-4103

GMC TRUCK & COACH DIVISION

GENERAL MOTORS CORPORATION

USE OF MANUAL

MANUAL GROUPS

This manual is divided into major groups as indicated on the tab index at right. Location of these groups can be readily found by the numerical black tab on the first page of each group which corresponds to numerical tab on this page. Some of the major groups are divided into sections, each section covering a specific unit or system, as shown in Section Index on opposite page.

PAGE AND ILLUSTRATION NUMBERS

The manual pages are numbered consecutively throughout the manual. Illustrations are numbered consecutively within each major group.

INDEXES

The Section Index on page 2 shows first page number of major groups, or first page number of each section when the major group is so divided. The alphabetical index starting on page 5 lists important items together with Manual page number references.

SPECIAL SECTIONS

A Trouble Shooting section, starting on page 205, is provided to facilitate analysis and correction of improper operation of the various units and systems. Information in this section is divided into systems or units corresponding to manual sections.

Special Tool section, starting on page 209, lists all of the special tools referred to throughout the manual, together with names and addresses of Vendors from whom the tools may be obtained.

All Wiring Diagrams are folded and secured on inside of back cover.

Every effort has been made to make the contents of this manual accessible, readable, and accurate. Your suggestions for further improvement of this manual are invited.

Index

Front Axle

1

Rear Axle

2

Body

3

Brakes

4

Clutch

5

Cooling

6

Electrical

7

Engine

8

Fuel

12

Lubrication

13

Springs

15

Steering

16

Transmission

17

Propeller Shaft

18

Wheels, Hubs and
Tires

19

Trouble Shooting

21

Special Tools

GM COACH MAINTENANCE MANUAL

GENERAL DATA

The data below includes only general information on models covered by this manual. Specific data and specifications will be found in "Specifications" section at end of each manual group. For convenience, index of general data items is shown below:

DATA	PAGE	DATA	PAGE
Cooling System Capacities	98	Max. Engine Speed	See Below
Diesel Engine Information	148	Lubricant Capacities	157
Fuel Tank Capacities	153	Rear Axle Ratios	27
Transmission Ratios	194		

MODEL DATA

PD-4103.

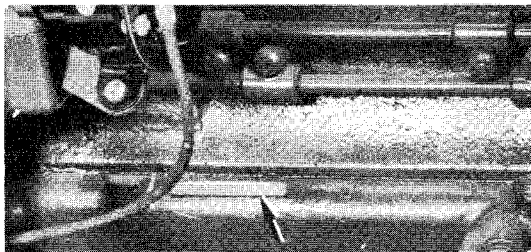
Wheelbase 247"
Tire Size.....11:00-20 Single front—Dual rear

Diesel Engine

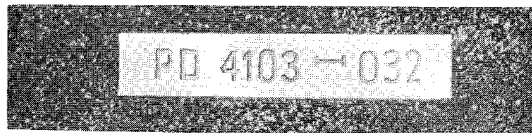
Model 6-71LA39
Piston Disp.—Cu. In.....425.6
Bore and Stroke.....4¼ in. x 5 in.
S.A.E. Horsepower.....43.35
Governed Engine Speed (no load) 2100 rpm

SERIAL NUMBER LOCATIONS

Delay and confusion can be avoided when correct serial numbers of vehicle are specified on parts orders and correspondence.



UPPER CORNER OF CYLINDER BLOCK NEAR GOVERNOR



FRAME AT RIGHT FRONT
WHEEL HOUSING

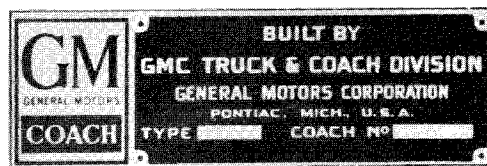
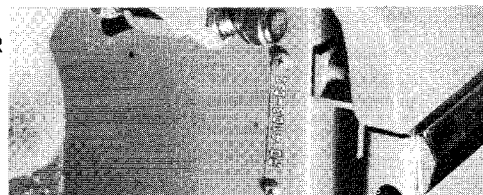


PLATE ON RIGHT-HAND SIDE OF DASH



DRIVER'S HEATER PANEL

TP-7133

INDEX

A	Page	D	Page
Accessories, Engine	142	Diesel Engine	141
Adjustments		Doors and Controls	35
Bearings, Wheel	199	Drag Link, Steering	177
Brake Application Valve	51		
Brake Shoe	44	E	
Brake Treadle	44	Electrical System	99
Clutch	179	Electric Horn	113
Compressor Unloader Valve	71	Emergency Door	35
Drag Link, Steering	177	Engine Comp't. Panel	105
Fog Lights	134	Engine Mounting	145
Generator Neutral Point	125	Engine Tune-up	141
Governor, Air Compressor	71	Entrance Door	35
Hand Brake	75		
Headlights	133	F	
Pressure Regulating Valve	48	Fan and Water Pump	97
Regulator, Generator	128	Filter, Fuel Oil	149
Relays	109	Filter, Lubricating Oil	143
Safety Valve	45	Front Axle	7
Steering Gear	171	Fuel Oil Specifications	154
Stop Screw, Steering Knuckle	10	Fuel System	149
Tie Rod	10		
Windshield Wiper Valve	38	G	
Air Brakes	43	Gauge, Air Pressure	46
Air Cleaners, Engine	151	Gauge, Oil Pressure	142
Air Compressor and Governor	63	Gauge Panel	100
Air Horns	38	Generator	121
Air Intake System, Engine	150	Generator Regulator	126
Alarm System, Tell-tale	107	Glass Replacement	36
Alignment, Front End	7	Governor, Air Compressor	71
Antifreeze Chart	98		
Application Valve, Brake	48	H	
Axle, Front	7	Hand Brake	75
Axle, Rear	17	Heating	39
		Horn, Electric	113
B		Horns, Air	38
Battery	115	Hubs and Bearings	199
Battery Junctions	106		
Bearings, Wheel	199	I	
Body	29	Injector Shut-off, Air Operated	144
Body Junction Panel	104		
Brake Chambers	55	L	
Brake Drums	61	Lighting System	132
Brake, Hand	75	Lights, Tell-tale	197
Brakes, Air	43	Links, Shock Absorber	168
Buzzer, Tell-tale Alarm	107	Low Air Pressure Switch	46
		Lubrication	155
C		Lubrication Chart	156
Capacity, Cooling System	98		
Check Valve, Aux. Air System	48	M	
Check Valve, Compressor Discharge	46	Moto-Gard	108
Chime, Passenger Signal	39		
Circuit Breaker Panel	102		
Clutch	179		
Compressor, Air	63		
Control Panel, Driver's	101		
Cooling System	89		

P

	<u>Page</u>
Painting	29
Pressure Regulating Valve, Air	47
Propeller Shaft	195

Q

Quick Release Valve	52
---------------------------	----

R

Radiator and Surge Tank	95
Radiator Shutter	95
Rear Axle	17
Rectifier, Alarm System	108
Regulator, Generator	126
Relays	109
Relay Valve	53

S

Safety Valve	45
Sash and Glass	36
Shock Absorbers	166
Shutter, Radiator	95
Slack Adjusters	56
Solenoid	
Emergency Stop	144
Engine Stop	144
Reverse, Transmission	182
Solenoids	112
Special Tools	209
Speedometer	113
Spring Suspension	163
Starter	117
Starting System	116

S (CONT'D.)

	<u>Page</u>
Steering Gear	171
Strainer, Lubricating Oil	142
Surge Tank	95
Sway Bar	169
Switch, Low Air Pressure	46
Switch, Low Oil Pressure	142
Switch Panel	101

T

Tell-tale Alarm System	107
Tell-tale Lights	107
Thermostat, Engine	89
Thermostat, Radiator Shutter	96
Thermostat, Water Overheat	91
Tie Rod, Front Axle	11
Tires	202
Tools, Special	209
Transmission	179
Trouble Shooting	205
Tune-up, Engine	141

V

Valve, Air Pressure Regulating	47
Valve, Brake Application	48
Valve, Quick Release	52
Valve, Relay	53
Ventilation	40

W

Wheels and Tires	202
Windshield Wipers	38
Wiring and Misc. Electrical	99

Front Axle

This group includes instructions on Front End Alignment and Maintenance and Repair on Front Axle Assembly.

Front End Alignment

Proper alignment of front wheels must be maintained to insure efficient steering and satisfactory tire life. The most important factors of front end alignment are: Wheel camber, axle caster, and wheel toe-in.

Front end alignment should be checked at regular intervals, and particularly after front axle has been subjected to heavy impacts such as a collision or a hard curb bump. Before checking alignment, wheel bearings must be properly adjusted since loose bearings will affect instrument readings when checking camber, king pin inclination, and toe-in.

When checking alignment, instructions outlined in this section should be followed carefully, as well as instructions covering related units such as brakes, springs, steering gear, hubs and bearings, and wheels and tires which are given in other sections of this manual.

Front end alignment chart (fig. 1) indicates points from which alignment dimensions are taken. "Specifications," at end of this section, lists correct alignment data for each model. This data should be followed when checking alignment, and checking should be done with precision equipment and instruments.

ALIGNMENT FACTORS

Front wheel toe-in, front wheel camber, axle caster, king pin inclination, and steering geometry are all factors of alignment and may be defined as follows:

Wheel Toe-In - Distance front wheels are closer together at front than at rear of axle. (See "J" and "H" on chart).

Wheel Camber - The amount of wheel inclination from a vertical position.

Positive Camber - Outward inclination of wheels at top. (See "C" on chart.)

Zero Camber - No inclination - wheels are held in vertical position.

Negative or Reverse Camber - Inward inclination of wheels at top.

Axle Caster - Inclination of king pin from the vertical in the fore and aft direction of the vehicle.

Positive Caster - Inclination of king pins toward rear of vehicle. (See "N" on chart.)

Zero Caster - King pins are held in a vertical position.

Negative or Reverse Caster - Inclination of king pins toward front of vehicle.

King Pin Inclination - The slant of the king pin toward the center of the vehicle at the top, and outward at the bottom. (See "D" on chart.)

Steering Geometry - The mechanics of keeping front wheels in proper relative alignment as wheels are turned to extreme right or left.

FRONT WHEEL TOE-IN

Toe-in offsets the effect of camber, thus preventing cross wear on tires. Since camber and toe-in are related items, both should be checked at the same time.

Where maximum allowable camber exists, tie rod should be adjusted to give wheels maximum allowable toe-in.

Before checking toe-in and camber, wheels must be in straight ahead position and correctly installed, and tires must be properly inflated.

Measure toe-in from centers of tire treads at height of wheel centers (see "I" and "H" on chart), using an accurate toe-in gauge.

FRONT WHEEL CAMBER

Camber ("C" on chart) offsets wheel deflection, due to wear of front axle parts, and prevents a reverse camber condition.

If camber is excessively positive or negative or is unequal, improper steering and excessive tire wear will result.

Camber variations may be caused by wear at wheel bearings and steering knuckle bushings, or by a bent steering knuckle or axle center.

CHECKING CAMBER

Before checking camber, check wear at wheel bearings and king pins as follows:

Jack up front of vehicle, pull bottom of wheel

FRONT END ALIGNMENT

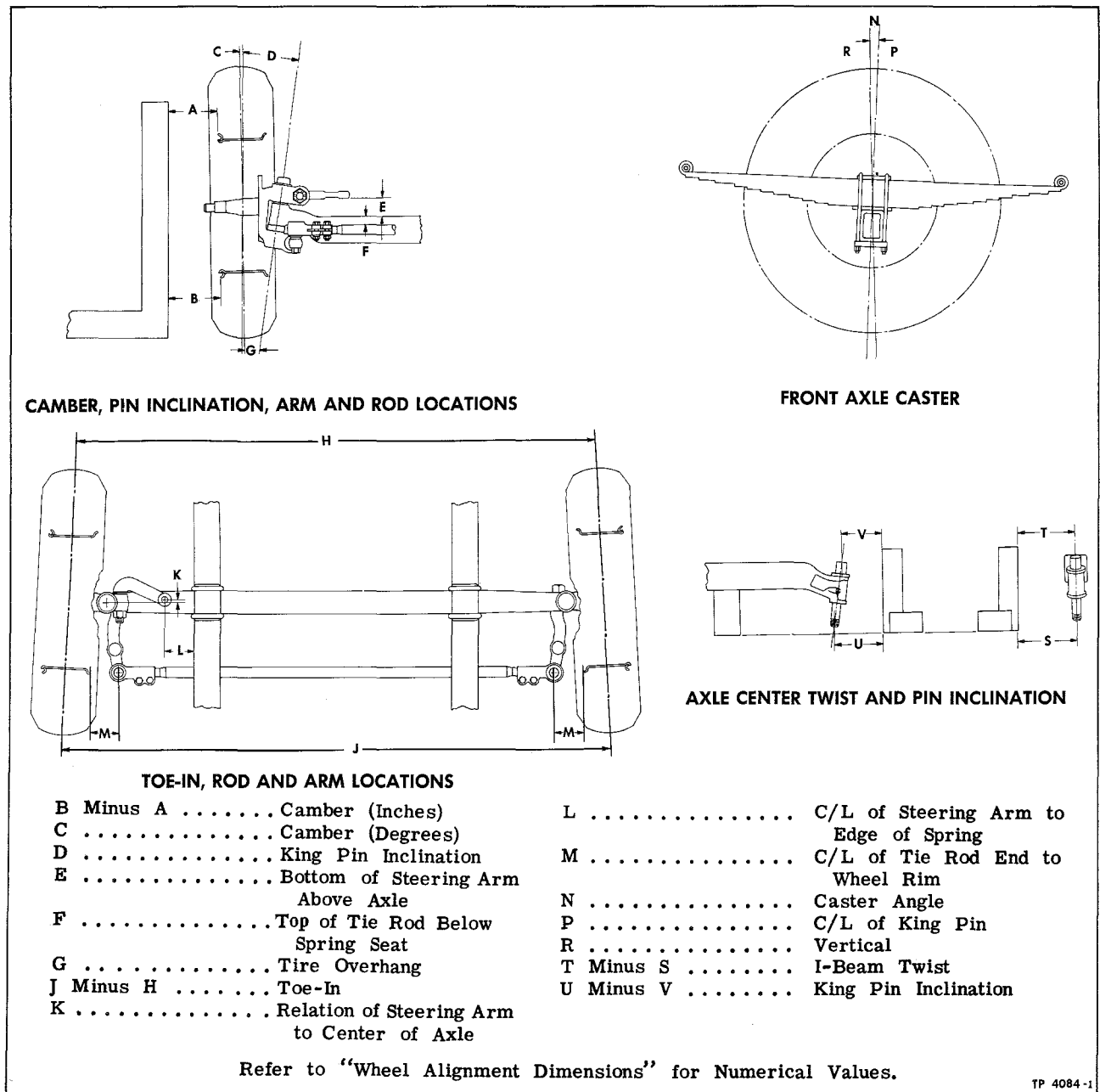


Figure 1—Front End Alignment Chart

outward and take a camber reading; then pull top of wheel outward and take a camber reading. If readings vary more than 1/4 degree, make following adjustments:

1. Adjust wheel bearings as directed in "HUBS AND BEARINGS" (SEC. 19); then take camber readings as previously instructed. If readings vary over 1/4 degree, replace steering knuckle bushings and king pins as instructed later in this section.

2. Check the wheel run-out as instructed in

"WHEELS AND TIRES" (SEC. 19). If run-out is excessive, straighten or replace wheel.

3. Place vehicle on level floor, with full weight on wheels, then take final camber reading. If camber gauge is not available, readings can be taken as shown on chart, (fig. 1). Place square as shown and measure distances "A" and "B." "B" should exceed "A" by amount listed in "Specifications" at end of this section. Camber dimensions of right wheel should not vary over 3/32" from camber dimensions of left wheel. If

FRONT AXLE REPAIR

final camber reading is incorrect, either steering knuckle or axle center is bent.

4. To determine which part is bent, check king pin inclination ("D" on chart). Camber plus king pin inclination is the included angle of steering knuckle. If included angle of knuckle varies more than 1/2 degree from value given in "Specifications," knuckle is bent and should be replaced.

AXLE CASTER

Caster ("N" on chart) provides the steering stability necessary to keep wheels in straight ahead position, assists in bringing vehicle out of a turn, and reduces tendency of wheels to shimmy.

Negative caster may cause wandering condition or difficulty in bringing vehicle out of a turn. Negative caster may result from sagging springs or a bent axle.

Excessive positive caster causes wheel shimmy and hard steering.

Uneven tightening of spring U-bolt nuts will affect caster; therefore, tighten all U-bolt nuts equally.

Check caster with full vehicle weight on wheels and with vehicle empty, using an accurate gauge.

If caster angle does not agree with specified value, check front axle components to determine cause.

KING PIN INCLINATION

King pins are inclined ("D," figure 1) to decrease friction between tires and road when turning. Special instruments must be used to check king pin inclination when axle is installed in vehicle. When axle is removed, check can be made on bench as follows:

Place two uniform blocks on level surface, then rest spring seats on blocks as shown in figure 1. Using square, measure "U" and "V" dimensions.

"U" minus "V" equals king pin inclination in inches.

While axle is set up on blocks, check axle center twist by measuring distances "S" and "T" (fig. 1). Difference between dimensions "S" and "T" equals axle center twist. If axle center is twisted, refer to "Straightening Axle Center," later in this section for corrective information.

STEERING GEOMETRY

Steering geometry is controlled by length and angularity of steering arms and linkage. Since a large part of driving is done with wheels in turning position, steering geometry is a very important alignment factor.

All other alignment factors must be correct and steering arms must be correctly installed before steering geometry is checked. Check following points using alignment instruments. Refer to figure 1.

1. Relative position of steering arm to axle spring seat, "E" on chart.

2. Relative position of tie rod to axle spring seat "F."

3. Relative position of steering arm to center line of axle, "K" on chart.

4. Center of steering arm to edge of spring, "L" on chart.

5. Relative position of tie rod ball to wheel rim, "M" on chart.

The important factors of front end alignment and the methods of checking and correcting errors are previously listed in this section. However, other front axle related units should be maintained in order to obtain correct steering. Refer to other sections of this manual for correction of such items as:

Front Wheel and Tire Balance
Front Wheel Bearing Adjustment
Front and Rear Spring Mounting
Steering Gear Adjustment

Front Axle Repair

Front axle assembly is reverse Elliott type. Axles are equipped with steering knuckles constructed as shown in figure 2.

Wheel bearings, springs, and brake parts which are mounted on front axle, are described in their respective manual sections.

Specifications and pertinent front axle service information is given in "Specifications" at end of section and in Front End Alignment Chart (fig. 1).

FRONT AXLE CONSTRUCTION

Front axle assembly center section is a hollow rectangular tube in which dowel pins are installed to locate spring seats. Outer ends of axle

are solid forgings machined to accommodate steering knuckles and king pins.

Steering knuckles (fig. 2) are supported on solid king pins which are tapered at center section to fit snugly in tapered holes in axle outer ends. Nut installed at threaded upper end of each king pin, locks king pin bushing (3) against spacer (4) and secures king pin in axle. King pin nuts are secured by cotter pins.

Load is transmitted from axle center to steering knuckles through tapered roller thrust bearing assemblies (9, fig. 2). Covers and plugs (2 and 9, fig. 2) exclude dust and moisture from knuckle bushings and serve as lubricant seals. Steering knuckle bushings can be replaced when necessary.

FRONT AXLE REPAIR

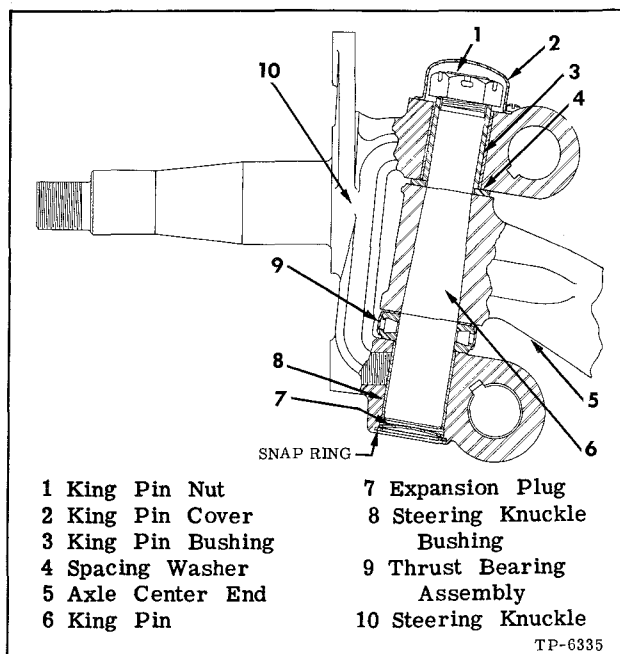


Figure 2—Steering Knuckle Cross Section

Stop screws installed at each end of center limit turning angle of front wheels.

FRONT AXLE GENERAL MAINTENANCE

INSPECTION

Following inspection operations should be performed at intervals determined by severity of service.

1. Inspect spring U-bolts for tightness. Tighten as directed in SPRING SUSPENSION (SEC. 15).
2. Inspect and tighten tie rod arm and steering arm nuts. Torque specifications are shown in "Specifications" at end of this section.
3. Inspect steering arm and tie rod arm nuts for looseness. Tighten if necessary. Also inspect tie rod end stud nuts for looseness and check tie rod ends for wear.
4. When steering difficulty or abnormal tire wear indicate necessity, check front end alignment as previously instructed under "Front End Alignment."
5. Check stop screws and adjust when necessary. Stop screw adjustment procedure is described later.
6. Lubricate front axle parts as instructed in LUBRICATION (SEC. 13).
7. When lubricating front axle parts, observe condition of seals at steering knuckle, tie rod ends, and drag link. If seals are found to be damaged or missing, new seals should be installed immediately.
8. Periodical inspection should be made at

steering knuckles to determine if excessive up-and-down movement of knuckles on king pins exists. Since excessive pounding will damage thrust bearing (9, fig. 2) the up-and-down movement of steering knuckles must be kept within prescribed limits. Shims for use in reducing clearance are available. Refer to "ADJUSTMENTS" later in section for method of checking clearance and making shim installation.

ADJUSTMENTS

A number of difficulties found during front end alignment check can be corrected by making adjustments at front axle assembly. Among these adjustments are; wheel bearing adjustment, tie rod and drag link adjustment, stop screw adjustment and brake adjustment. All the above mentioned adjustment procedures except tie rod and stop screw adjustment are covered in other sections of manual.

TIE ROD ADJUSTMENT

Tie rod adjustment is necessary whenever front wheel toe-in is found to be incorrect. Adjust tie rod as follows:

1. Set front wheels in straight-ahead position.
2. Loosen clamp bolts at both ends of tie rod.
3. Use pipe wrench to turn tie rod tube as required to correct toe in measurement. Refer to "FRONT END ALIGNMENT" previously in this section for method of measuring toe-in.
4. When adjustment is completed, make sure tie rod ends are in same plane, then tighten clamp bolts.

STOP SCREW ADJUSTMENT

Stop screws installed in front axle center limit front wheel turning angle to right and left. Stop screws must be set properly to give equal turning radius to the right and to left, as well as to limit turning angle and thereby prevent interference between front tires and other parts of coach.

Before setting stop screws, refer to STEERING GEAR (SEC. 16) and be sure pitman arm is properly installed on steering gear and be sure steering gear drag link is properly adjusted for length and not distorted or bent.

Adjust stop screws as follows:

1. Raise front axle until front wheels are off floor.
2. Turn front wheels to extreme left. In this position there should be 1/2 inch clearance between tire and drag link. If necessary, turn stop screw in or out to provide 1/2 inch clearance mentioned above. Secure stop screw setting with lock nut.
3. With wheels turned to extreme left position measure and record distance from left front tire to outer edge of front spring at nearest point.

FRONT AXLE REPAIR

4. Turn wheels to extreme right position and measure distance from right front tire to outer edge of front spring at nearest point. If this di-

mension is not same as the corresponding dimension at left-hand side of coach, adjust right stop screw to provide same dimensions.

FRONT AXLE OVERHAUL

Steering knuckles, king pins, and bushings can be replaced, and minor axle straightening can be performed, without removing front axle assembly from vehicle. However, when front axle assembly requires a complete overhaul, the assembly may be removed, overhauled and installed, as described below.

Certain preliminary inspections can be made, while axle is still mounted on vehicle, which will aid in determining the amount of repair work necessary. Check front end alignment as directed in "Front End Alignment" previously in this section. Inability to align front end correctly indicates that axle center or steering knuckle has been distorted, steering arms have been bent, or bushings in steering knuckle yokes are worn beyond limits. Repair procedures on such items as, brakes, shock absorbers, wheel bearings, and steering gear are covered in respective sections of this manual.

FRONT AXLE REMOVAL

1. Loosen wheel nuts, then raise front of vehicle with jack or chain hoist and block vehicle behind front axle.

2. Disconnect drag link from steering arm by removing drag link end stud nut and driving tapered stud out of arm at steering knuckle.

3. Disconnect air lines at brake chambers.

4. Disconnect shock absorbers and both ends of each front spring in manner described in SPRING SUSPENSION (SEC. 15).

NOTE: U-bolts which clamp springs onto axle may be removed to permit removal of axle assembly without removing front springs. Refer to SPRING SUSPENSION (SEC. 15) for details of spring installation.

5. After axle assembly has been completely detached from coach, roll the assembly out from under vehicle.

TIE ROD REPAIR

Tie rod assembly used is three-piece type comprised of a rod and two end assemblies. Tube is threaded into ends and locked with clamp bolts. Right-and left-hand threads are provided on tie rod to facilitate toe-in adjustment.

Tie rod ends (fig. 3) are constructed so as to automatically compensate for wear on bearing surfaces. Tie rod end stud is held in contact

with bearing surfaces by tension of spring which holds seat firmly against inner end of stud. Tie rod end parts are held in place by an end plug retained by lock ring.

Normal wear on bearing surface in tie rod end, will cause increase in overall height of assembly. If excessive play is noted, the parts which are worn must be replaced, or a new tie rod end assembly must be installed.

TIE ROD DISASSEMBLY (Fig. 4)

1. Remove cotter pins and nuts from tie rod ends, support steering arm to prevent bending then drive tie rod end tapered stud out of steering arm. Remove spring (2), dust cover (3), seal (4), and retainer (5) from stud.

2. Loosen clamp bolts, then remove tie rod end assembly from tube.

3. Pry end plug lock (15) out of groove in body (7); then remove plug (14), seat and spring (12 and 13), and grease retainer (11). Stud and bearing assembly can now be removed from body.

INSPECTION

Clean all parts of tie rod end then inspect parts for wear and check tension of spring (13, fig. 4). Discard worn parts and replace spring if broken or weak.

ASSEMBLING TIE ROD ENDS (Fig. 4)

1. Lubricate parts with lubricant specified in LUBRICATION (SEC. 13) before assembling tie rod ends.

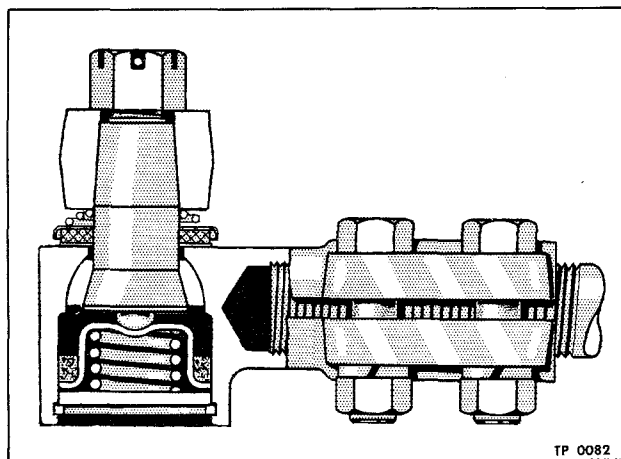


Figure 3—Tie Rod End Construction

FRONT AXLE REPAIR

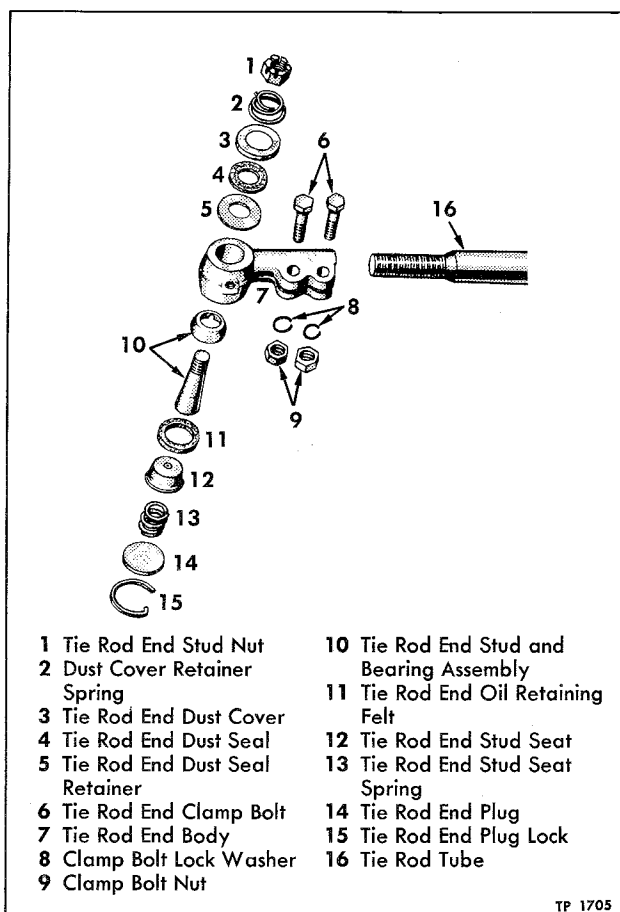


Figure 4—Disassembled View of Tie Rod End

2. Insert end stud and bearing assembly (10) into tie rod end body (7), place oil retaining felt (11) over end of end stud seat (12), then position seat (12) in body (7).

3. Place stud seat spring (13) inside seat (12), lay end plug (14) on spring, then compress spring (13) and install end plug lock (15) in groove in body (7).

4. Thread tie rod end assemblies on tie rod tube (16), install clamp bolts (6), new lock washers (8), and nuts (9). Do not tighten nuts (9) at this time.

5. Carefully clean tapered portion of tie rod end studs (1), then install dust seal retainers (5), dust seals (4), dust covers (3), and dust retainer springs (2) on end studs in order named.

6. Clean tapered holes in steering tie rod arms, position complete tie rod assembly on steering arms, then thread stud nuts (1) on end studs (10). Tighten stud nuts to minimum torque given in "Specifications" at end of this section, then tighten nuts until next castellation on nut lines up with cotter pin holes in studs. Install new cotter pin full size of hole.

STEERING KNUCKLE DISASSEMBLY

If desired, steering knuckles may be removed from front axle without removing front axle assembly from the vehicle. To remove steering knuckles from axle after axle has been removed from vehicle, proceed as follows:

1. Remove tie rod and ends assembly from steering tie rod arms as directed under "Tie Rod Repair" covered previously in this section.

2. Remove front wheels and hubs, as directed in HUBS, WHEELS, AND TIRES (SEC. 19).

3. Remove brake mechanism, including brake chambers, slack adjusters and brake shoes as directed in AIR BRAKES (SEC. 4).

4. Remove nuts and washers from studs which attach brake spider to steering knuckle flange; then remove spider and camshaft as an assembly.

5. Remove cotter pins, nuts, and washers from steering tie rod arms, then drive arms out of steering knuckles using a lead hammer. Also remove drag link arm from left-hand knuckle.

6. Remove cap screws which attach dust cap to steering knuckle, then remove dust cap and gasket. Discard gasket.

7. Remove lock ring from knuckle lower yoke, and remove plug (7, fig. 2). Remove nut from top of king pin, then using large brass drift, drive king pin out of axle and knuckle.

8. Remove knuckle and thrust bearing and spacing washer from axle. King pin bushing will remain in knuckle upper yoke and can be lifted from yoke as soon as king pin is removed.

CLEANING

Wash steering knuckle parts in cleaning solution, being sure to remove all dirt and lubricant. If necessary, soak thrust bearings in cleaner until all old lubricant is dissolved; then slush bearing in cleaning solution until all grit is removed from races.

INSPECTION AND REPAIR

STEERING KNUCKLES

After steering knuckles have been cleaned thoroughly, examine knuckles for distortion, damage, cracks or fractures. If Magna Flux inspection equipment is available, use this method to inspect steering knuckles and king pins for minute cracks, checks, or fractures, which otherwise would not be visible to the naked eye.

AXLE CENTER

There are two conditions which, if either exists, will necessitate replacement of axle center.

1. If king pin holes in axle center ends are worn to such an extent that a new pin fits loosely,

FRONT AXLE REPAIR

axle center must be replaced.

2. If axle center has been twisted or bent more than 5 degrees from original shape, the center should be replaced. As a general rule, when an extreme bent condition exists, minute fractures which may be invisible will occur, and failure under ordinary operating conditions will result.

CHECKING AXLE CENTER

Check axle center for twist with alignment instruments, or on a bench as illustrated in front alignment chart (fig. 1). If equipment is available, use Magna-Flux method to check axle center for minute fractures.

STRAIGHTENING AXLE CENTER

The straightening of axle forgings must be performed by mechanics who are thoroughly familiar with such operations and the use of special straightening tools. **ALWAYS STRAIGHTEN FORGINGS COLD -- UNDER NO CIRCUMSTANCES SHOULD HEAT BE APPLIED.** Application of heat to facilitate straightening weakens the material strength of all forgings.

THRUST BEARING

Examine thrust bearings for excessive wear, pitting, or other damage. If these conditions are evident, discard bearing and install new part when assembling axle. If bearing retainers are bent or damaged, bearings should be replaced.

BUSHING REPLACEMENT

Steering knuckle bushings should be replaced if inspection reveals that they are scored, worn, or otherwise damaged; or if results given under "Checking Camber" in "Front End Alignment", previously in this section.

Bushing dimensions are given in specifications. Replace bushings if not within limits.

Removal

1. Clamp steering knuckle securely in vise equipped with soft jaws.

2. Thread tap, of suitable size, into bushing if bushing driver is not available.

3. Using soft metal rod, slightly smaller than bushing and long enough to extend about 1-1/2 inches through opposite knuckle yoke; drive tap and bushing out of knuckle bore.

4. Repeat process to remove remaining steering knuckle bushing.

Installation

1. Clean the steering knuckle bushing bores, then round off all sharp edges of new bushings, slightly.

2. Position bushing so that oil hole in bushing

will line up with lubrication fitting hole in steering knuckle yoke, and so that bushing will enter knuckle bore straight when pressed into yoke.

3. Press bushing into knuckle bore, using arbor press or suitable driver, until positioned as shown in figure 1. **NEVER ATTEMPT TO DRIVE BUSHINGS WITH HAMMER.**

4. Burnish or ream bushings to diameter given in "Specifications" at end of this section, using either a two step reamer or a burnishing tool. Tool used must have a long pilot bar or be long enough to finish both upper and lower bushings at the same time.

5. Clean cuttings out of oil grooves, then round off all sharp edges in grooves.

KING PIN

Check diameter of king pin, at upper and lower bearing surfaces, against dimensions given in "Specifications" at end of this section. If wear exceeds limits given, replace with new king pin.

King pins should also be inspected for minute cracks or other damage. Any burrs or grooves may be honed out provided such honing will not reduce diameter of pin below limits given in "Specifications" at end of this section.

STEERING KNUCKLE INSTALLATION

The importance of cleanliness, when assembling steering knuckle parts, can not be over-stressed. If king pins and bushings are installed with particles of dirt or metal between bearing surfaces, excessive wear will result necessitating premature replacement of parts.

Install steering knuckles and king pins in the following manner: Key numbers in text refer to figure 2.

1. Position steering knuckle (10) on axle center end (5), then slide thrust bearing assembly (9) into place between lower face of axle center and steering knuckle lower yoke. Make sure retainer is on top of bearing with lip of retainer down. Align king pin holes in steering knuckle yokes with king pin hole in axle center end.

2. With axle center held rigidly, place a jack under knuckle yoke and raise knuckle sufficiently to take up all clearance between lower yoke, thrust bearing, and lower face of axle center end.

3. Check clearance between top face of axle center end and lower face of steering knuckle yoke, then select shim and spacing washer combination which will reduce clearance to limits given in "Specifications" at end of this section. Shim and spacing washer thicknesses available are given in "Specifications" at end of this section.

4. Make certain king pin hole in axle center (5), king pin (6), and nut (1), are carefully cleaned and dry. King pin nut (1) should screw on king

FRONT AXLE REPAIR

pin freely without binding in any manner. These precautions should be taken to assure king pin being securely locked in place, when installation is completed.

5. Insert king pin (6) through bottom yoke of steering knuckle (10), then drive king pin into place with lead hammer.

6. Place king pin bushing (3) over threaded end of king pin (6), then press bushing into place. Be sure king pin bushing is installed squarely on king pin.

7. Make sure threads on king pin nut are clean and dry, then install king pin nut (1). Tighten nut, with torque wrench, to minimum torque given in "Specifications" at end of this section, then tighten nut until next castellation on nut lines up with cotter pin hole through king pin. Install new cotter pin, full size of cotter pin hole.

8. Position new dust cap gasket on steering knuckle upper yoke, place dust cap (2) on gasket, then secure cap with attaching screws.

9. Install new plug (7) in lower yoke, then install lock ring to retain plug. Install plug with concave side toward lock ring so edge of plug contacts ring.

10. Check turning torque of assembled steering knuckle. Place torque wrench on nut and measure torque required to turn knuckle. If reading is not within limits given in "Specifications" at end of this section, disassemble steering knuckle and recheck all parts until cause is found.

NOTE: Turning torque can also be measured by use of a spring scale. Attach scale at extreme end of steering knuckle spindle, pull on scale and note reading when knuckle is in motion. Multiply reading by distance in feet, from end of spindle to center line of king pin.

11. Place arm keys in keyways machined in steering arm and steering tie rod arms. After making sure tapered holes in knuckle yoke and tapered ends of arms are clean and dry, insert arms in yokes. Place lock washers and nuts on steering tie rod arms, tighten nuts to minimum torque given in "Specifications" at end of this

section, then tighten nut until next castellation on nut lines up with cotter pin hole in arm. Install new cotter pin full size of hole. Place brake chamber bracket on steering arm, using dowel in steering knuckle upper yoke to locate bracket correctly, then install new lock washer and nut. Tighten nut to minimum torque given in "Specifications" at end of this section, then tighten nut until next castellation on nut lines up with cotter pin hole in arm. Install new cotter pin.

12. Position brake spider and camshaft, as an assembly, on steering knuckle; then install new lock washers and nuts. Tighten nuts securely.

13. Install front brake shoes as instructed under "Brake Shoe Installation" in AIR BRAKES (SEC. 4).

14. Connect and adjust brake chamber push rods at slack adjusters as directed in AIR BRAKES (SEC. 4).

15. Install wheel bearings, hubs and brake drums, following instructions in HUBS, WHEELS, AND TIRES.

16. Install tie rod assembly with the tie rod end with right-hand thread toward right-hand side of axle.

FRONT AXLE INSTALLATION

1. Install spring assemblies on axle as directed in SPRING SUSPENSION (SEC. 15); then roll the complete assembly into place under coach.

2. Attach springs at brackets and shackles referring to SPRING SUSPENSION (SEC. 15) for instructions. Also connect shock absorbers to axle.

3. Connect air lines to brake chambers, then check and adjust brakes. Refer to AIR BRAKES (SEC. 4).

4. Connect drag link to steering arm.

5. Remove blocking and lower vehicle to floor, then re-check wheel nuts and spring U-bolt nuts.

6. Lubricate front axle assembly as instructed in LUBRICATION (SEC. 13).

7. Check front end alignment and adjust front wheel toe-in. Refer to "Front End Alignment" Chart (fig. 1) and "Specifications" at end of section for alignment and toe-in dimensions.

FRONT AXLE SPECIFICATIONS

Specifications

(New Limits)

WHEEL ALIGNMENT DIMENSIONS		
(Refer to Alignment Chart, Fig. 1)		
B-A	Wheel Camber (Inches)	13/32"
C	Wheel Camber (Degrees)	
	Loose Axle	1° ± 1/4°
	Axle Installed	1/2°
D	King Pin Inclination (Degrees)	5-1/2°
E	Bottom of Steering Arm Above Axle (Spring Seat)	3-5/16"
F	Top of Tie Rod Below Spring Seat	1-1/2"
J-H	Toe-In	1/16" to 1/8"
K	Relation of Steering Arm to Axle Center Line	7/8" Ahead
L	Center of Steering Arm to Edge of Spring Tubular Axle	2-3/4"
M	Center of Tie Rod End to Wheel Rim	3-1/8"
N	Caster Angle	3-1/2"
T-S	Axle Center Twist	Equal
U-V	King Pin Inclination (Inches)	1-1/32"

STEERING KNUCKLE

Spindle Diameter	
At Inner Wheel Bearing	2.5613-2.5623"
At Outer Wheel Bearing	2.1243-2.1248"
Steering Knuckle Bushings	
Inner Diameter	1.7965-1.7975"
Length	2-3/16"
King Pin Bushings	
Inner Diameter	1.310-1.311"
Outer Diameter	1.7950-1.7960"
Length	2-15/32"

KING PIN

Diameter at Top of Pin	1.309-1.310"
Diameter at Bottom of Pin	1.7950-1.7960"
Length (Overall)	10-25/32"

FITS AND TOLERANCES

Clearance Between	
King Pin Bushing and Knuckle Bushing	0.0005-0.0025"
King Pin and Lower Knuckle Bushing	0.0005-0.0025"
King Pin and King Pin Bushing	0.000-0.002"
Steering Knuckle Thrust	0.015" Maximum
Thrust Adjustment	With Shims and Spacers
Shim Thickness Available - 1@	0.015"
Spacing Washer Thickness Available	0.093", 0.125", & 0.156"

NOTES

Rear Axle

Rear axle is full-floating type, using a one piece axle housing with housing bowl cover welded to housing. Housing bowl is located to the left of axle center line.

As shown in figure 3, drive pinion assembly is mounted at an angle to drive gear, thus increasing the tooth contact area between drive gear and drive pinion gear teeth. Drive is transmitted from transmission angle drive unit through propeller shaft to spiral bevel gears, axle housing, and springs, then to vehicle underframe.

Differential and drive pinion assemblies are both provided with facilities for adjustment of bearings and gear tooth contact.

DIFFERENTIAL CARRIER

Differential assembly, drive pinion, and pinion cage assembly, are mounted in differential carrier. After axle shafts have been removed, and propeller shaft has been disconnected, differential carrier can be removed for inspection and adjustment without removing axle housing from vehicle.

DIFFERENTIAL ASSEMBLY

Conventional four-pinion type differential is carried in two-piece case mounted on tapered roller bearings. Bevel drive gear is bolted to flanged half of differential case. Drive gear and pinion are furnished in matched, lapped sets, and should always be installed as such to assure satisfactory operation.

Thrust washers are used between differential side gears and case and between differential pinions and case. Each pinion contains an aluminum-bronze bushing. When bushings become worn, pinions must be replaced. Differential case halves are held together with special bolts and slotted nuts, locked in place with lock wire.

DIFFERENTIAL SIDE BEARINGS

Differential case is supported in tapered roller

bearings which take thrust as well as radial loads. Bearings are mounted in machined supports in differential carrier with thrust loads taken by adjusting rings threaded into carrier supports and bearing caps. Adjusting rings bear against bearing cups and are locked in position by adjusting ring locks bolted to each bearing cap.

PINION AND CAGE ASSEMBLY

Bevel drive pinion is installed at an angle in differential carrier. Pinion is straddle mounted in two opposed tapered roller bearings at outer end, and one straight roller bearing at inner end.

Tapered roller bearing cups are installed in pinion cage (fig. 3), and are separated by a machined shoulder in pinion cage assembly.

Pinion bearings are adjusted on shaft by selecting correct spacer combination as described later in this section, under "Pinion and Cage Assembly."

Straight roller bearing at inner end of drive pinion, is secured in place with retainer and a bolt.

Shims of various thicknesses are used between bearing cage and differential carrier to adjust drive pinion tooth contact and gear backlash.

Pinion shaft and cage assembly cannot be removed from carrier until differential case assembly including drive gear has been removed from carrier.

AXLE SHAFT AND HOUSING

Axle shafts are full floating type. Drive flange at outer ends have external teeth which mesh with similar internal teeth on hub drive plate. Drive plate is doweled to hub with dowel pins and held in place, together with plate cover, with ten hub studs and nuts as illustrated in figure 1.

Axle housing is one-piece design with differential located off center. Housing is equipped with removable outer end tubes which are threaded to accommodate wheel bearing adjusting nuts.

AXLE MAINTENANCE ON VEHICLE

The following maintenance operations should be accomplished at regular inspection and lubrication intervals.

LUBRICATION

Lubrication intervals, method of filling and

draining, also type of lubricant for axle is covered in LUBRICATION (SEC. 13).

Check for lubricant leaks at differential housing, at pinion bearing oil seal and at cover plate at outer end of hubs. Eliminate leaks by tightening nuts or bolts or by replacing gaskets or oil seal.

REAR AXLE

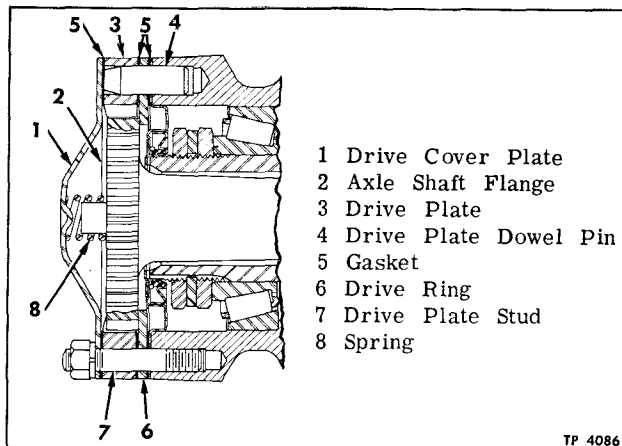


Figure 1—Axle Shaft and Drive Plate Installation

MOUNTING

Check rear spring U-bolts for tightness at regular intervals as directed in SPRING SUSPENSION (SEC. 15).

Rear springs are used to hold rear axle in alignment, therefore when rear axle alignment difficulties occur, the rear spring suspension units should be checked before checking axle assembly. Refer to TROUBLE SHOOTING (SEC. 21) for suggestions on how to determine alignment difficulties.

AXLE SHAFT DRIVE PLATE AND COVER (Refer to Figure 1)

Rear axle shafts are installed as shown in figure 1. Drive plate (3) and cover plate (1) are held on hub with ten drive studs and nuts and dowel pins (4). Three gaskets (5), to prevent lubricant leaks, are used between parts as shown.

Spring (8) prevents endwise movement of axle shaft. Keep stud nuts tight to prevent drive plate loosening on dowels and to prevent lubricant leaks.

Rear axle outer oil seal assembly is installed between drive ring (6) and hub. HUBS, WHEELS, AND TIRES (SEC. 19) contains complete oil seal information.

REAR AXLE OVERHAUL

Rear axle assembly may be disassembled while the housing remains attached to springs if proper equipment is available for handling differential assembly. Information on propeller shaft, rear springs, hubs and bearings, brakes and wheels and tires will be found in other sections of this manual.

REAR AXLE REMOVAL

1. Block coach in raised position and remove rear wheels.
2. Disconnect air lines at brake chambers.
3. Disconnect propeller shaft at axle flange.
4. Remove rear spring U-bolts, disconnect

AXLE SHAFT REPLACEMENT

Axle shaft splines at inner end are free fit in differential side gears; and teeth at flange on outer end of shaft also are free in drive plate. A suitable handle for removing and installing axle shafts can be provided by attaching slide hammer assembly (J-2654) to outer end of axle shaft. Axle shaft flange has hole tapped with 1/2 x 13 N.C. thread and the above tool can be screwed into this hole to provide means of withdrawing axle shaft from housing. Above tool also provides a handle which can be used to support axle shaft while guiding inner end into differential side gear splines during installation.

AXLE SHAFT REMOVAL (Fig. 1)

1. Remove stud nuts holding drive plate (3) and cover (1) on hub.

2. Remove cover (1), spring (8), and outer gasket (5). Screw threaded end of slide hammer (J-2654) into tapped hole in axle shaft flange; then pull axle shaft out of housing.

3. Drive plate (3) has three tapped holes into which puller screws can be installed for removing plate from hub. To remove plate, turn puller screws alternately until plate is free from dowels. Drive ring (6) and gaskets may be removed after drive plate is removed.

AXLE SHAFT INSTALLATION

1. If drive plate (3) and ring (6) have been removed, install ring using one gasket on each side; then install drive plate over studs and dowels. Use a stud nut and washer on stud at each dowel pin to draw plate (3) into place. Tighten stud nuts alternately to draw plate squarely into place.

2. Lubricate splines on axle shaft, then guide axle shaft into housing so that splines enter differential side gear, and teeth on flange mate with teeth on drive plate.

3. Place outer gasket (5) at hub; then install spring (8) and cover (1). Install studs nuts with new lock washers. Tighten studs nuts to 55 to 66 foot pounds using torque wrench.

sway bar and shock absorbers (if used).

5. Support axle assembly on dolly jack, then disconnect rear springs at rear shackles. Refer to SPRING SUSPENSION (SEC. 15) for details on spring and shackle construction.

6. Remove rear axle assembly from coach.

REAR AXLE

REAR AXLE REPAIR

The following instructions provide procedures for complete disassembly, cleaning, inspection, repair, and reassembly of rear axle. Axle housing may be checked for bent condition before axle assembly is removed from coach. The following repair procedure is based on the operations necessary when axle is removed from coach.

AXLE HOUSING CHECK

At regular inspection intervals, or if conditions indicate that rear axle housing might be bent, housing should be checked, using the following method. This check can be made before or after axle is removed from coach to determine if axle housing is sprung. Conventional camber and toe-in gauges can be used to perform inspection.

1. Support axle in level position using blocks at each spring seat; then check rear wheel bearing adjustment referring to HUBS, WHEELS, AND BEARINGS (SEC. 19) for bearing information.

2. Check run-out at each rear wheel and replace wheels having run-out in excess of $3/32$ inch.

3. Check for toe-in and camber at rear wheels. Rear wheels should not toe in or out more than $1/8$ inch, and camber should be zero, plus or minus $1/4$ degree. If measurements are not within the above dimensions, bent or sprung axle housing is indicated. Make notation of the existing conditions for use when making corrections later.

4. In cases where bent axle housings are indicated, further checks to determine exact location of bend should be made after rear axle has been disassembled; and necessary steps taken to correct the condition. Any straightening should be done with axle housing COLD, UNDER NO CIRCUMSTANCES SHOULD HEAT BE APPLIED.

AXLE DISASSEMBLY

(Key Numbers in Text Refer to Fig. 3)

Before and during disassembly operations, perform following inspections and check all adjustments to determine repairs required.

1. Visually inspect exterior of housing for leaks and damage; then clean outside of housing using suitable cleaning equipment.

2. After differential assembly is removed from housing, check pinion bearings for end play. Check differential case assembly run-out and backlash before removal of differential and make note of same for later reference during repair.

DIFFERENTIAL CARRIER REMOVAL (Fig. 3)

1. Remove axle shafts as previously instructed under "Axle Shaft Replacement" in this section.

2. Remove drain plug and drain lubricant from

housing, then loosen differential carrier stud nuts.

3. Remove stud nuts (34) and lock washers (35) from differential carrier studs (33).

4. Be certain that differential carrier is supported solidly, then proceed to pull complete carrier assembly out of housing.

DIFFERENTIAL REMOVAL FROM CARRIER

(Fig. 3)

1. Remove lock wire from bolts (6) which lock adjusting rings (38).

2. Remove nuts from differential side bearing cap studs. Make certain that bearing caps (41) and carrier are marked before removal; then remove side bearing caps (41) and cups (40). Lift out differential assembly including drive gear (1) and side bearings (39). Remove side bearing adjusting rings (38).

DIFFERENTIAL CASE DISASSEMBLY (Fig. 3)

1. Mark both halves of case (11) so halves may be reassembled in original positions (fig. 2).

2. Remove side bearings (39) from each half of case, using special bearing puller CS-1047 as shown in figure 4.

3. Remove lock wire and nuts (4) from bolts (43) which hold the two halves of differential case (11) together; then separate halves of case (11).

4. Remove side gears (9), thrust washers (10) and (3), spider (2), and pinions (42) from differential case (11).

5. If either drive gear (1) or drive pinion (29)

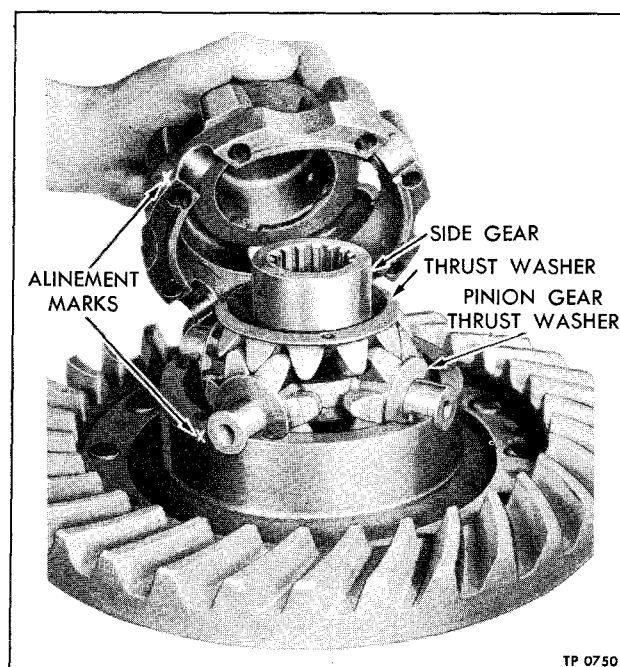


Figure 2—Differential Case Alignment Marks

REAR AXLE

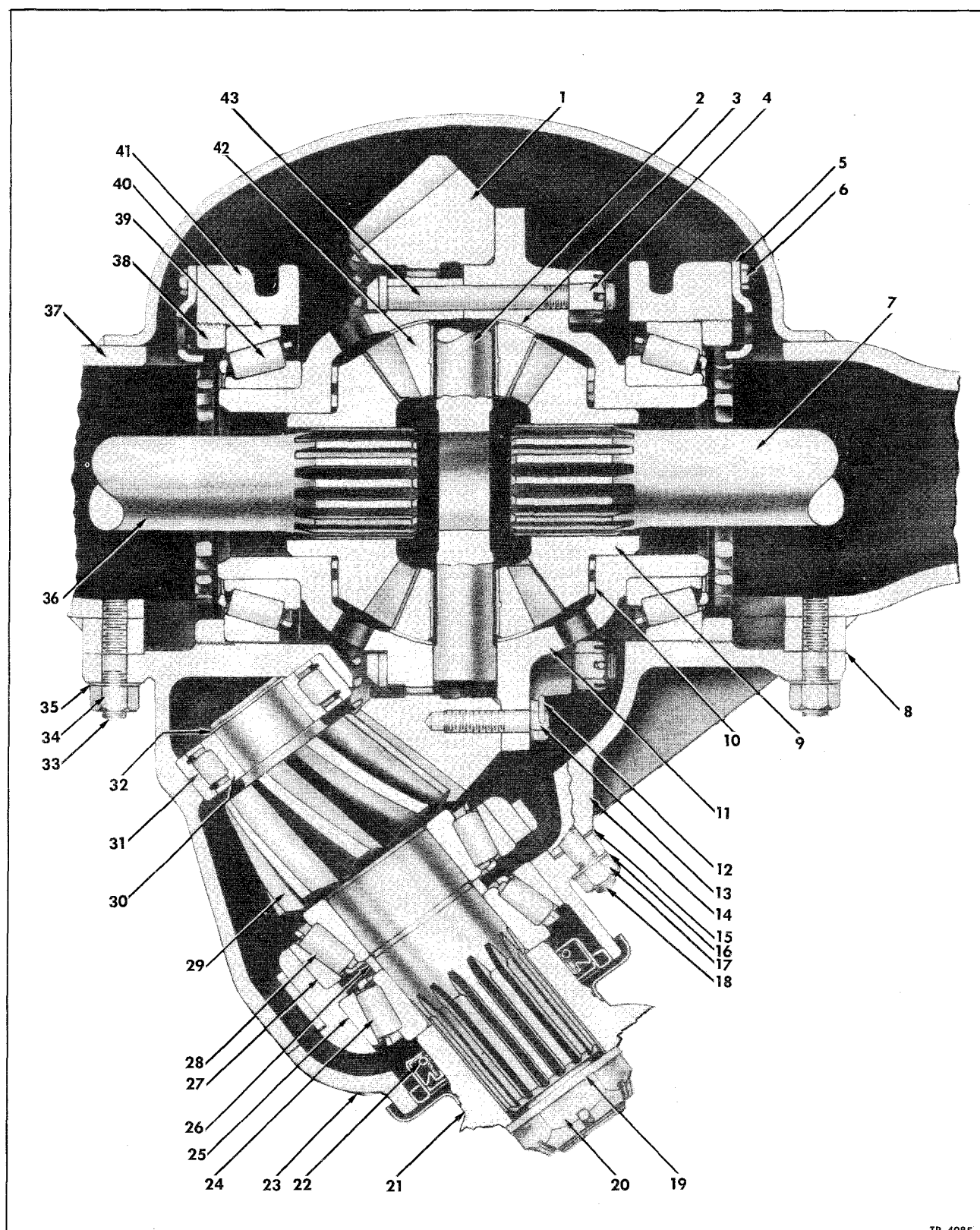


Figure 3—Sectional View of Rear Axle

REAR AXLE

1 Drive Gear	16 Lock Washer	30 Pinion Bearing Inner Race (Part of Item 31)
2 Differential Spider	17 Pinion Cage Stud Nut	31 Drive Pinion Inner Bearing
3 Differential Pinion Thrust Washer	18 Pinion Cage Stud	32 Inner Bearing Retainer Ring
4 Differential Case Bolt Nut	19 Drive Pinion Nut Washer	33 Differential Carrier Stud
5 Adjusting Ring Lock	20 Drive Pinion Nut	34 Differential Carrier Stud Nut
6 Adjusting Ring Lock Bolt	21 Propeller Shaft Flange	35 Lock Washer
7 Axle Shaft (Right Hand)	22 Oil Seal Assembly	36 Axle Shaft (Left Hand)
8 Differential Carrier Gasket	23 Pinion Cage and Bearing Cup Assembly	37 Axle Housing Assembly
9 Differential Side Gear	24 Drive Pinion Outer Bearing Cone	38 Differential Bearing Adjusting Ring
10 Differential Side Gear Thrust Washer	25 Outer Bearing Cup	39 Differential Side Bearing Cone
11 Differential Case Assembly	26 Drive Pinion Bearing Spacer	40 Differential Side Bearing Cup
12 Drive Gear Bolt Lock Wire	27 Inner Bearing Cup	41 Differential Bearing Cap
13 Drive Gear Bolt	28 Drive Pinion Inner Bearing Cone	42 Differential Pinion
14 Differential Carrier Assembly	29 Drive Pinion	43 Differential Case Bolt
15 Pinion Cage Shims		TP-4085-1B

Legend for Figure 3

are worn or damaged, both must be replaced as a matched set. Never replace drive pinion or drive gear separately.

PINION CAGE REMOVAL AND DISASSEMBLY

(Refer to Fig. 3)

1. Mark pinion cage (23) and differential carrier (14) so parts can be reassembled in the same relative position. Remove nuts (17) and lock washers (16) which secure pinion cage (23) on differential carrier (14).

2. Install puller screws and tighten alternately and evenly to pull cage (23) out of carrier; then noting quantity, remove shim pack (15) from pinion cage studs (18). Tie shims (15) together so same shim pack may be used at reassembly.

3. Remove retainer ring (32) which secures inner bearing (31) on drive pinion (29). Remove inner bearing (31) from drive pinion (29) with a suitable puller.

4. Clamp propeller shaft flange (21) in vise equipped with padded jaws. Remove cotter pin, nut (20), and washer (19) from drive pinion (29).

5. Place cage and drive pinion assembly in an arbor press and press drive pinion (29) out of flange (21) and pinion cage. Outer bearing (24) will remain in pinion cage.

6. Remove spacer (26) from drive pinion (29). Using special bearing puller (CS-1047) remove inner bearing (28) from drive pinion (29). Remove oil seal (22). Inspect bearing cups (25) and (27). If bearing cups must be removed from cage (23), use brass drift and carefully drive cups out of pinion cage.

CLEANING, INSPECTION, AND REPAIR

CLEANING BEARINGS

The importance of proper bearing cleaning cannot be over-emphasized. Bearings should always be cleaned separately from other rear axle parts. When cleaning bearings, be sure to perform all of the following steps.

1. Soak differential and drive pinion bearings in clean kerosene or Diesel fuel oil.

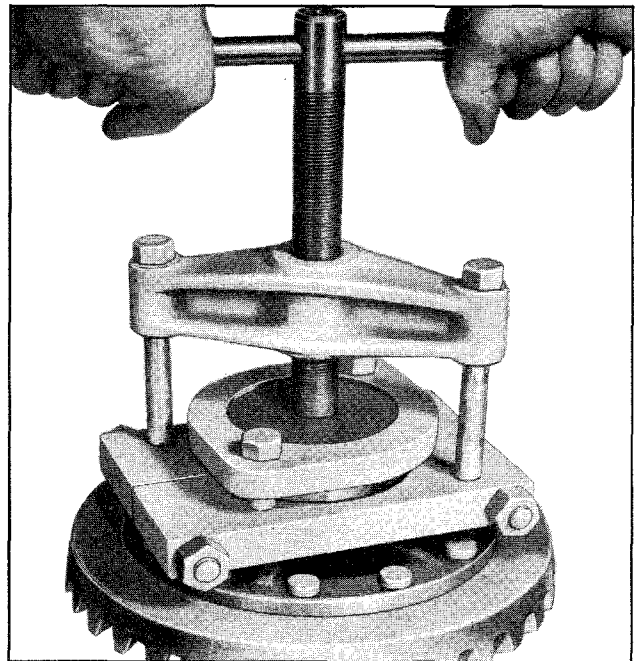


Figure 4—Differential Side Bearing Removal

REAR AXLE

Gasoline, which is sometimes used as a bearing cleaner, should not be used. Also, bearings should never be placed in a hot solution tank for cleaning.

2. After old lubricant is loosened, hold bearing races so that bearings cannot rotate, then brush bearings with soft bristled brush until all grit and dirt has been removed.

3. Rinse bearings in clean fluid; then, while holding races, blow dry with compressed air. Be sure air stream is moisture free.

4. Inspect bearings as instructed under "Inspection Operations" later in this section. If bearings pass inspection, dip bearings in differential lubricant, recommended in LUBRICATION (SEC. 13), then wrap bearings in clean cloth or paper until ready to reassemble axle.

CLEANING PARTS

Immerse all parts in suitable cleaning fluid and clean parts thoroughly. Use a stiff bristle brush to remove all old lubricant. Remove particles of gaskets which may adhere to mating faces of axle housing, differential carrier, hubs, and axle shaft flanges. Clean out lubricant channels in pinion cage and differential carrier. Clean housing breather. Make certain that interior of axle housing is thoroughly cleaned.

INSPECTION

Whenever available, the Magna Flux method should be used on all steel parts, except ball and roller bearings. This method is especially suited for inspection of ground or highly finished surfaces for wear and cracks which otherwise would not be visible to the naked eye.

INSPECTION OPERATIONS

1. Bearings. Rotate each bearing slowly, and at the same time examine bearing for roughness, damage, defects, or wear. Note condition of bearing cage. Replace bearing if cage is damaged or if any of the conditions previously noted exist.

2. Gears. Examine drive gear, drive pinion, and differential side gears for damaged teeth, worn spots in surface hardening, and distortion. Examine bushings in differential pinions for grooves, or excessive wear, and check fit of gears on spider. Refer to "Specifications" later in this section for limits. Check radial clearances between differential side gear hubs and bores in differential carrier.

3. Differential Case. Inspect differential case assembly for cracks, distortion, or damage. If case is in good condition, thoroughly clean case and cover; then assemble case with bolts and mount in lathe centers or "V" block stand. If lathe is not available, install differential side bearings and mount case in differential carrier as di-

rected under "Differential and Drive Gear Installation" later in this section. Install dial indicator and check differential case run-out. Refer to "Specifications" at end of this section, for run-out limits. Whenever run-out exceeds limits, differential case run-out may be corrected as later described under "Repair" in this section.

4. Axle Shafts. Examine splined end of axle shaft for twisted or cracked splines, twisted shaft, or damaged teeth on flange. If any of above conditions are evident, install new axle shafts.

5. Axle Shaft and Flange Run-Out. Install axle shaft assembly in lathe centers or "V" blocks. Check shaft run-out with dial indicator; if run-out exceeds limits listed in "Specifications" at end of this section, discard axle shaft. Position dial indicator so that indicator shaft end contacts inner surface of flange near outer edge, then check flange run-out. If run-out exceeds limits listed in "Specifications" at end of this section, discard axle shaft.

AXLE HOUSING INSPECTION

If check made prior to disassembly of axle indicated a bent condition at axle housing, make more complete check of housing on surface plate and after locating point at which housing is bent, the housing may be straightened if equipment is available. Any straightening must be done with axle housing COLD DO NOT APPLY HEAT TO HOUSING.

OIL SEAL INSPECTION

Replacement of spring loaded oil seal when unit is disassembled is more economical than premature overhaul to replace these parts at a future time. Further, loss of lubricant through a worn seal may result in failure of other parts, such as gears and bearings.

Handle seals carefully, particularly when seals are being installed. Cutting, scratching or curling under of lip of seal seriously impairs efficiency of seal. Use of Permatex or equivalent around outer diameter of seal is recommended to insure against leakage at that point.

REPAIR

Differential Case. Excessive run-out on differential case may be corrected by machining flange on gear side of case. Remove sufficient metal from flange to correct excessive run-out. Metal must be cut on a true plane removing just enough metal to bring run-out within limits listed in "Specifications" at end of this section. After differential case has been machined, remove burrs and clean case assembly thoroughly.

Propeller shaft Flange. Whenever inspection indicates that exterior surface of flange which contacts oil seal is corroded or pitted, the condition

REAR AXLE

may be corrected by cleaning and polishing surface with a suitable abrasive cloth. If cleaning and polishing surface of flange does not clear up the condition, discard flange and install new parts.

AXLE ASSEMBLY

After all parts have been thoroughly cleaned, apply a thin coating of differential lubricant, as specified in LUBRICATION (SEC. 13), on all thrust or bearing surfaces. Coating parts will prevent scoring when vehicle is first placed in service.

Use of new lock washers, gaskets, and oil seals is recommended during assembly of axle. Check condition of threads on all bolts, screws, and studs before installation. Discard if damaged in anyway.

All adjustments, given in assembly procedures must be made carefully to insure efficient and continuous axle operation.

DRIVE PINION AND CAGE ASSEMBLY (Fig. 3)

1. If pinion bearing cups (25 and 27) were removed during disassembly, press bearing cups firmly against pinion bearing cage (23) shoulders.

2. Position pinion bearing (28) on drive pinion (29), with widest part of bearing cone toward gear teeth, then press bearing on pinion until bearing cone seats solidly against drive pinion teeth.

3. Position drive pinion inner bearing (31) on drive pinion (29), and use arbor press to force bearing into place. Install retainer ring (32) to retain bearing.

4. Install pinion bearing spacer (26) on drive pinion, then lubricate pinion bearing cones and cups with light engine oil.

5. Insert drive pinion (29) and bearing assembly into pinion cage (23); then, using an arbor press, press outer pinion bearing (24) firmly against bearing spacer (26). Rotate bearing cage through several complete revolutions to assure normal bearing contact.

6. While assembly is still in press under pressure, check drive pinion bearing pre-load. Wrap soft wire around pinion bearing cage (23) as shown in figure 5. Attach pound scale to wire, then pull on scale, keeping scale in a horizontal plane. Note scale reading when assembly is rotating freely. Reading should be from 12 to 18 inch pounds. To compute inch-pound value of scale reading, multiply scale reading (pounds) by one-half pinion cage diameter (inches). If reading does not fall between limits given, use thinner spacer to increase or thicker spacer to decrease pinion bearing pre-load. Spacer thicknesses available are given in "Specifications" at end of this section.

NOTE: If arbor press is not available, temporarily install propeller shaft flange (21), washer (19), and nut (20). Tighten nut to 800-900 foot pounds torque, then check pinion bearing pre-load

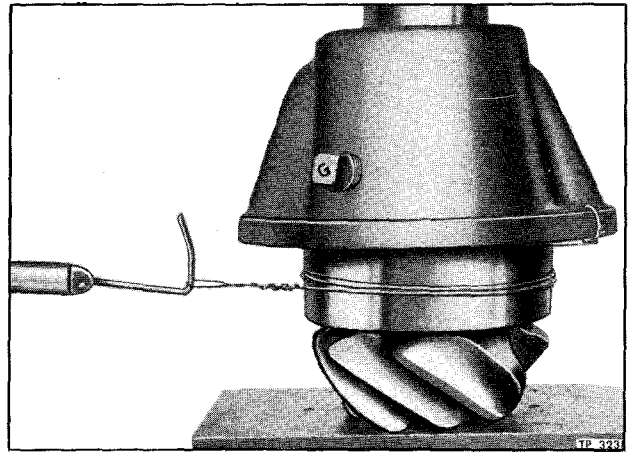


Figure 5—Checking Pinion Bearing Preload

as directed in preceding paragraph. Remove nut, washer, and flange after adjustment.

7. After bearing pre-load adjustment is completed, lubricate oil seal assembly (22) and cover outer edge of seal body with a non-hardening sealing compound; then install seal in pinion cage (23) using a suitable driver.

8. Clean splines on drive pinion (29) and propeller shaft flange splines, then install flange on drive pinion. Place washer (19) on drive pinion (29), then install nut (20). Tighten nut to minimum torque of 800 foot pounds, then tighten nut until next castellation on nut lines up with cotter pin hole in drive pinion and install cotter pin.

DRIVE PINION INSTALLATION (Fig. 3)

1. Lubricate inner end of drive pinion with differential lubricant recommended in LUBRICATION (SEC. 13).

2. Place pinion cage shims (15) over pinion cage studs (18), then position drive pinion and cage assembly on studs (18). IMPORTANT: Oil holes in shims (15) and cage assembly (23) must line up with oil passages in differential carrier assembly (14), when installed, to assure proper lubrication of drive pinion bearings (24 and 28).

3. Install new lock washers (16) and nuts (17) on studs (18). Tighten nuts (17) to 85-95 foot-pounds torque.

DIFFERENTIAL CASE ASSEMBLY (Fig. 3)

After checking differential case runout as previously described under "Cleaning, Inspection, and Repair" in this section, assemble differential case as follows:

1. Lubricate differential case inner walls and all component parts of differential assembly with lubricant specified in LUBRICATION (SEC. 13).

2. Position side gear thrust washer (10) on hub of side gear (9), then place gear in right-hand

REAR AXLE

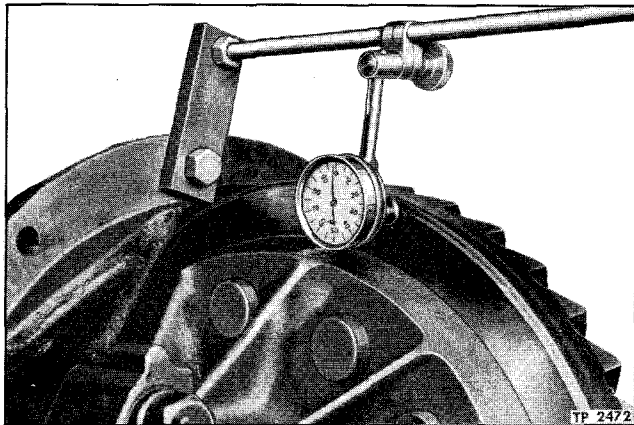


Figure 6—Measuring Drive Gear Run-Out

(flanged) section of differential case (11).

3. Lay right-hand section of case on bench with flange upward, place differential pinions (42) and pinion thrust washers (3) on differential spider (1), place pinion and spider assembly on side gear (9), then install remaining side gear (9) and thrust washer (10).

4. Place left-hand section of differential case on right-hand section with alignment marks positioned as shown in figure 3, then insert case bolts (43) downward through left-hand section.

5. Install nuts (4) on bolts (43), tighten to minimum torque (155-200 foot-pounds). Tighten each nut until next castellation of nut lines up with hole in bolt, then install lock wire through all bolts.

6. Position drive gear (1) on differential case (11) flange, then install attaching bolts (13). Tight-

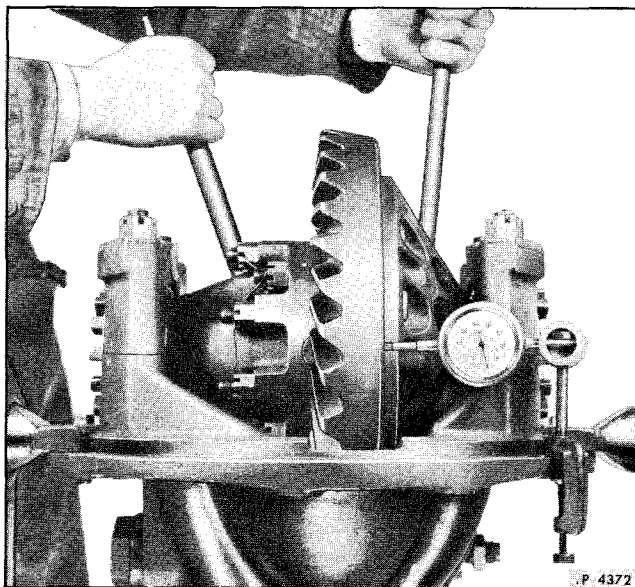


Figure 7—Differential Bearing Preload Adjustment

en bolts securely, then install lock wire (12) through bolt heads in such a manner that lock wire will become tighter if bolts loosen.

7. Press differential side bearings (39) on hubs of differential case (14) until bearing cones seat firmly.

DIFFERENTIAL AND DRIVE GEAR INSTALLATION (Fig. 3)

1. Coat differential side bearing cones (39) and cups (40) with lubricant specified in LUBRICATION (SEC. 13).

2. Place bearing cups (40) over bearing cones (39), then position differential and gear assembly in differential carrier (14).

3. Insert bearing adjusting rings (38) and turn hand tight against bearing cups (39).

4. Place differential bearing caps (41) over studs with alignment marks in line, then tap lightly into position.

CAUTION: If bearing caps do not seat easily and properly, adjusting rings may be cross-threaded. Remove bearing caps and reposition adjusting rings. Forcing caps into position will result in irreparable damage to differential carrier or to bearing caps.

5. Install washers and nuts on bearing cap studs, tighten nuts snugly, then back nuts off until bearing adjusting rings (38) can be turned.

6. Tighten adjusting rings (38), alternately, until bearings (39) are seated in bearing cups (40). Revolve differential assembly after each tightening to keep bearing cups straight in bores.

7. After side bearings (39) are firmly seated, tighten left-hand adjusting ring one or two notches, then check drive gear run-out in manner shown in figure 6. Run-out should be within limits given in "Specifications" at end of this section.

DIFFERENTIAL BEARING PRELOAD ADJUSTMENT

1. Using dial indicator at back face of drive gear (1) as shown in figure 7, loosen bearing adjusting ring (38), on side opposite bearing, enough to notice end play on dial indicator.

2. Tighten the same adjusting ring until .000" end play is obtained.

3. Tighten adjusting rings (38) one notch each from .000 end play position to impose correct preload on differential side bearings (39).

NOTE: After adjusting bearing pre-load, proceed with tooth contact and backlash adjustment as directed in following paragraph.

GEAR TOOTH CONTACT ADJUSTMENT (Fig. 8)

Drive pinion (29) is adjusted for tooth contact by means of shims (15) between pinion cage (23) and differential carrier (14). Drive gear (1) is adjusted by means of adjusting rings (38).

REAR AXLE

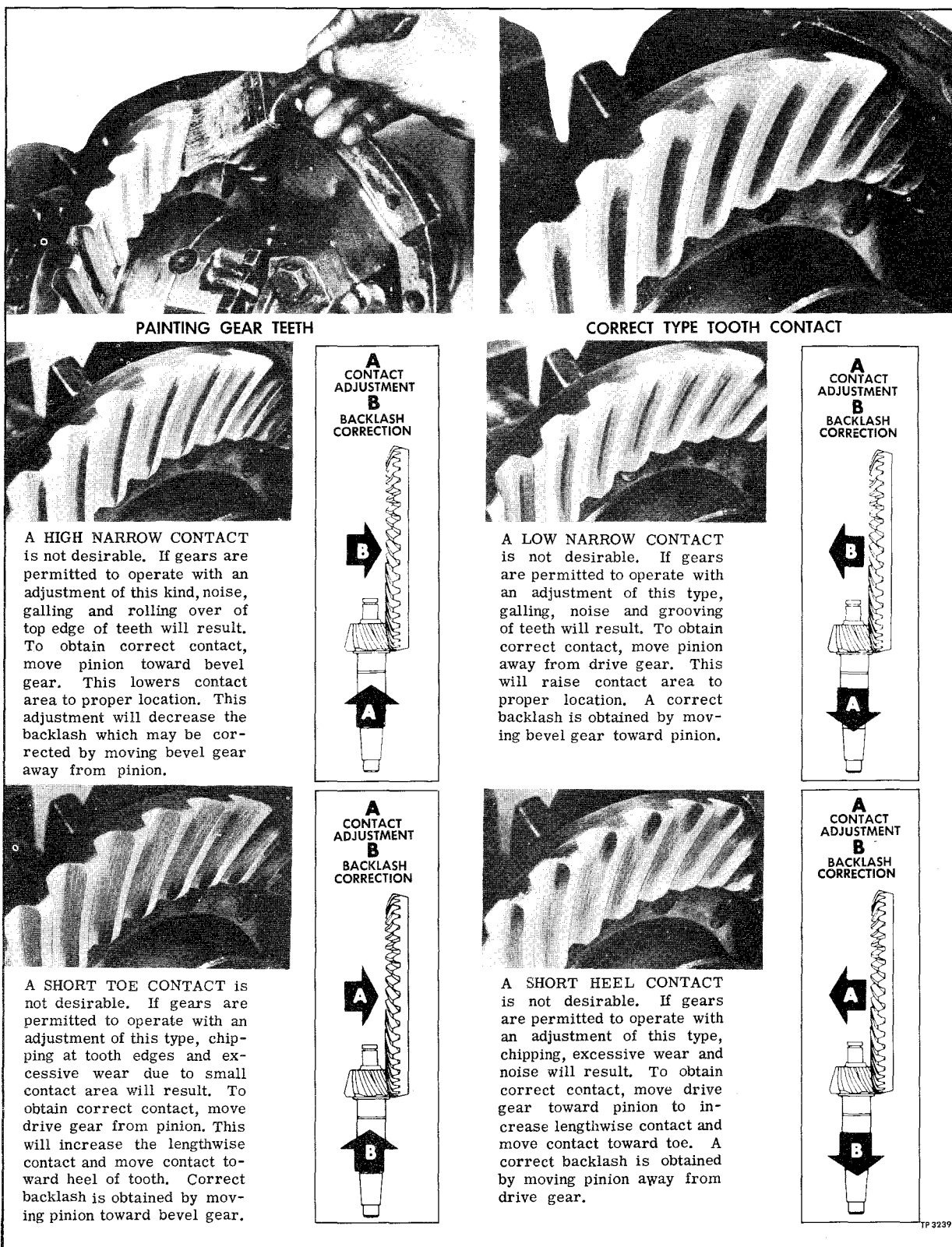


Figure 8—Gear Tooth Contact Chart

REAR AXLE

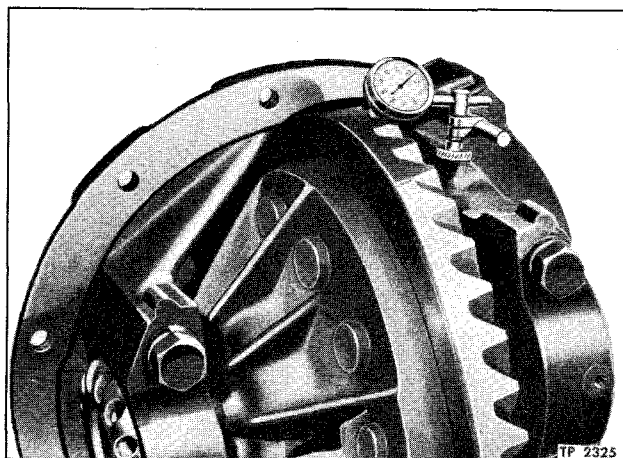


Figure 9—Checking Drive Gear Backlash (Typical)

If original gears are reinstalled in assembly, painting gear teeth will not indicate the same contact as new gears and can be misleading. Gears that have been in service for extensive periods, form running contacts due to wear on teeth. Therefore, the original shim pack (15) plus one .005" shim should be maintained to check backlash. Figure 9 shows typical method of checking backlash.

In the event that backlash exceeds maximum tolerances, reduce backlash only in the amount that will avoid overlap of worn teeth.

When new gears are to be installed, differential bearings and drive pinion bearings must be in proper adjustment before any attempt is made to adjust backlash. Check backlash with dial indicator as shown in figure 9, and adjust to obtain 0.006 - 0.012" lash. Adjust backlash and tooth contact in the following manner:

1. Paint at least ten teeth of bevel gear with a mixture of red lead or prussian blue and engine oil. Rotate gears through a few revolutions in both directions by hand. Refer to gear tooth contact charts, figure 8, for directions for making proper adjustments.

2. When satisfactory tooth contact and backlash has been obtained, tighten bearing cap bolts securely (300-350 ft. lbs.). Install adjusting ring locks (5) and secure bolts (6) with lock wire.

DIFFERENTIAL CARRIER INSTALLATION (Fig. 3)

1. Clean flanges of differential carrier (14) and axle housing (37), then position new differential carrier gasket (8) on carrier studs (33).

2. Roll differential carrier into position on roller jack. Start carrier into housing with four flat washers (35) and nuts (34) equally spaced, then tighten nuts alternately to draw carrier squarely into housing. CAUTION: Driving carrier

into axle housing by use of a steel hammer will not only damage carrier stud flange but will also cause oil leaks.

3. Remove nuts and flat washers, then install lock washers and stud nuts. Tighten nuts to 140-155 foot pounds torque.

4. If housing has not been removed from vehicle, connect propeller shaft to propeller shaft flange (21) as instructed in PROPELLER SHAFT (SEC. 18).

5. Install drain plug and tighten firmly. Fill axle housing to proper level with lubricant specified in LUBRICATION (SEC. 13). Replace and tighten filler plug.

COMPLETING ASSEMBLY

1. Before installing axle shafts (7 and 36), be sure that hubs have been removed, cleaned, inspected, and adjusted as directed in HUBS, WHEELS, AND TIRES (SEC. 19).

3. Referring to figure 1, install axle shafts as directed previously under "Axle Shaft Installation" in this section.

REAR AXLE INSTALLATION

1. Using dolly jack, roll axle assembly into position under coach.

2. Install rear spring U-bolts, referring to SPRING SUSPENSION (SEC. 15) for pertinent instructions; and also assemble shackles at rear end of springs.

3. Connect sway bar and shock absorbers (if used).

4. Refer to PROPELLER SHAFT (SEC. 18) for necessary information, and connect propeller shaft to rear axle.

5. Connect air lines to brake chambers.

6. Install rear wheels, remove blocking and lower coach so weight is supported on axle; then retighten spring U-bolts and wheel nuts.

LUBRICATION

Lubricants generally available for differentials thicken considerably after use due to oxidation and chemical reactions resulting from normal service conditions. This thickening seriously impairs lubricating qualities of lubricant and, if neglected, will finally result in semi-solids which will adhere to sides of housing and afford no lubrication whatever. It is essential, that, in addition to checking level of lubricant, its condition should be also considered. If there is any evidence of thickening, differential should be drained and thoroughly cleaned. Checking level and condition of lubricant frequently, together with periodic draining and refilling, is the best way to prevent lubricant thickening. Proper interval for refilling, as well as correct lubricant, is given in LUBRICATION (SEC. 13).

REAR AXLE SPECIFICATIONS

SPECIFICATIONS

(New Limits)

Type Spiral Bevel With Angle Pinion

Drive Hotchkiss
Housing Banjo TypeDifferential

Number of Pinions 4

GEAR RATIOS

Standard 3-5/9:1 3.62:1

Optional 4-1/8:1

Differential Bearing Adjustment Threaded Adjusting Rings (See Text)

Differential Case Run-Out 0.002 Max.

Side Gear Thrust Washer Thickness 0.121" - 0.125"

Pinion Thrust Washer Thickness 0.058" - 0.062"

Clearance Between

Pinion and Spider 0.003" - 0.007"

Side Gear Hub and Case 0.008" - 0.012"

Drive Pinion Cage Assembly

Inner Bearing Straight Roller

Outer Bearings Tapered Roller

Adjustment Selective Spacers (See Text)

Drive Pinion Spacers 0.187" - 0.188" - 0.190" 0.192"

0.194" - 0.196" - 0.198" - 0.200"

0.201" - 0.215" - 0.229"

Rotating Torque (in. lbs.) 12 to 18

Drive Pinion Backlash Adjustment Shims

Shim Sizes Available 3 @ 0.005" - 0.010" - 0.020"

Axle Shafts

Type Full Floating

Drive Flange Run-out Not to Exceed 0.005"

Shaft Run-out at Center 1/16"

Number of Splines 16

Backlash Between

Side Gear and Axle Shaft Splines 0.001" - 0.005"

Diameter - At Splined End 2.372" - 2.377"

TORQUE SPECIFICATIONS (Ft. Lbs.)

Propeller Shaft Yoke Nut 800 Min.

Pinion Cage Stud Nuts 85 - 95

Carrier to Housing Stud Nuts 140 - 155

Axle Drive Plate Stud Nuts 59 - 66

Differential Case Bolt Nuts 155 - 200

Adjusting Ring Lock Bolts 15 - 20

Differential Bearing Cap Stud Nuts 300 - 350

NOTES

Body

GENERAL MAINTENANCE

The body comprises the main structure of the vehicle. Unlike conventional motor cars and trucks, separate frame is not used; all units such as power plant, running gear, steering system, etc., being attached directly to body. Low center of gravity, reduction of weight, and flexibility of structure are achieved through this design without sacrifice of strength.

Since separate frame is not used, all road shock, driving and braking stresses, etc., are absorbed in body framing and outer panels. A small amount of twist or undulation occurs in body, as complete rigidity of the structure is not desirable. It is therefore important that body be regularly inspected for loose rivets and bolts.

Entire vehicle should be regularly inspected for condition of paint and for corrosion damage, with particular attention given to underside. Inspection should be made more frequently in freezing weather due to the corrosive effect of road de-icing materials (salt, calcium chloride, etc.) on metal. If inspection discloses any evidences of corrosion, paint failure, or bare metal, corrective measures as outlined under "Painting" (later in this section) should be immediately employed.

EXTERIOR MAINTENANCE

Body painted surfaces and polished side mouldings should be protected by a coating of wax, applied at regular intervals. Periods between applications should be sufficiently short to assure continuous protection of the finish. Any good body wax can be used for both painted and polished surfaces. Wax should be applied immediately after coach has been cleaned, by spraying or other means. Wax should be rubbed down either with a lamb's wool polishing wheel or by hand.

Both polished and painted surfaces can be cleaned with mild soap and water. When necessary to remove previous wax coating, gasoline or similar solvents meeting local fire and health regulations may be employed.

Hard, anodized finish on side mouldings is produced by an electrochemical process. Anodic coating is abrasion-resistant and may be cleaned, if necessary, with a mild abrasive cleaner. However, this finish, like other aluminum, is attacked by many acids and most alkalis. Consequently, considerable care should be taken in the selection of chemical cleaners. Joints in side panels make

use of even inhibited alkaline cleaners inadvisable, due to difficulty in removing all traces of cleaner.

INTERIOR MAINTENANCE

Cleaning Painted Surfaces

Clean surface with cloth dampened in cleaning solvent, then rub with polishing compound. Rub with clean cloth until original finish is restored.

Cleaning Rubber

Use soap and water for cleaning rubber. Do not use gasoline, since gasoline attacks rubber.

Cleaning Metal

Use paint thinner or any good metal polishing compound for unpainted metal surfaces.

Cleaning Window Glass

Use any standard cleaner which does not attack paint. Apply cleaning solution, then rub with cloth dampened in water. Rub with clean cheese cloth until dry.

PAINTING

Aluminum corrodes just as iron and steel rusts; under certain conditions aluminum will corrode more rapidly than steel. Vehicles should therefore be inspected regularly for corrosion damage and for condition of paint coatings, in order that corrective measures may be applied as necessary.

REPAINTING ALUMINUM PARTS

1. Thorough cleaning is essential. All corrosion products, grease and other foreign matter must be removed. Solvent cleaning, pressure steam cleaning, wire brushing, and hand sanding methods are recommended.

2. Completely remove old paint by use of organic solvents - do not use alkaline paint remover on aluminum. If old primer is very difficult to remove and there is no evidence of metal corrosion, old primer may be left on, but all loose paint must be removed.

3. Apply warm 5% sodium dichromate or potassium dichromate solution (two ounces dichromate in one quart of water) to cleaned surfaces. Apply by spraying. Allow parts to dry.

4. Use a zinc chromate primer such as DuPont 63-1016 or Arco 214-30089, or any equivalent material made by a reputable manufacturer.

Apply primer, preferably by spraying, in a

BODY

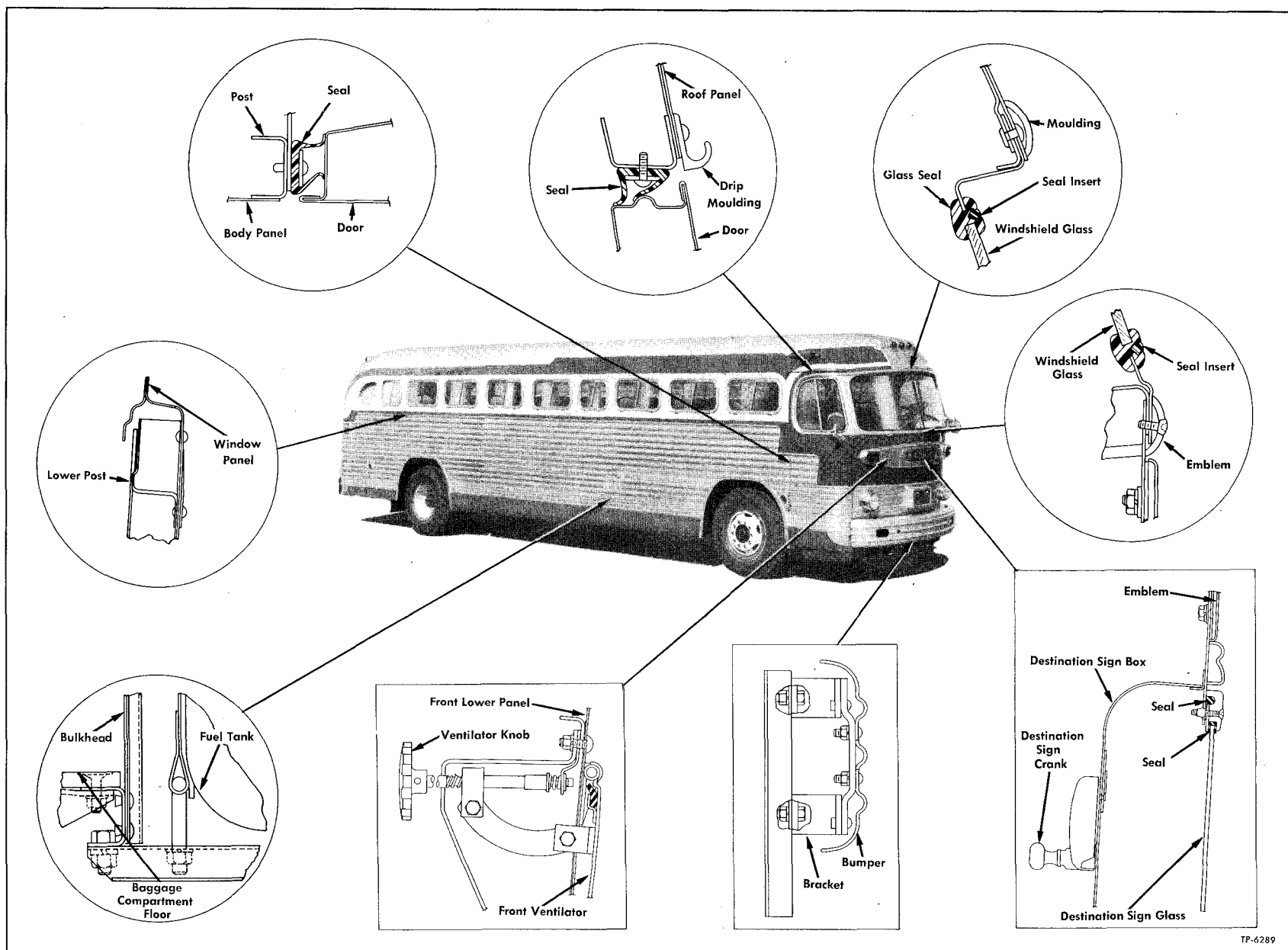


Figure 1—Front Three-Quarter View Showing Constructional Details of Body

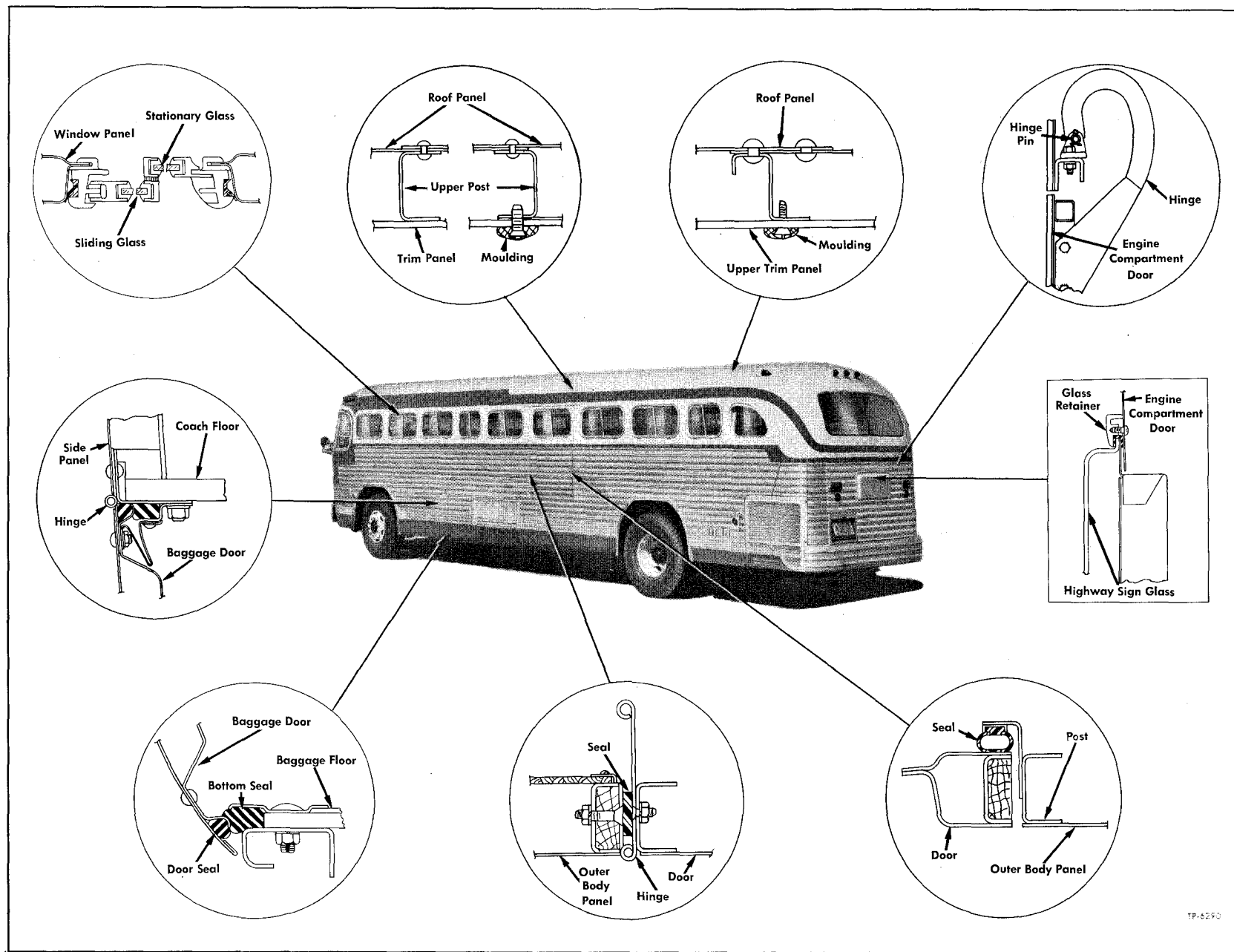


Figure 2—Rear Three-Quarter View Showing Constructional Details of Body

BODY

very thin coat. Properly applied primer will be greenish in color; yellow color indicates too heavy a coating. If zinc chromate primer cannot be obtained, use of a red oxide primer is recommended, but only as an emergency measure.

5. Apply finish coats:

a. For understructure and other parts not requiring color, apply two coats of the following, or equivalent: Reduce 5 parts of DuPont RC-147 clear Dulux with 1 part Duco #3637 Thinner. To each gallon add 2 pounds Albron (aluminum) paste, stirring mixture thoroughly.

If synthetic aluminum enamel is not available, any synthetic or other enamel, aluminum lacquer, or other lacquer, in that order, may be used; but only materials made by a reputable manufacturer should be employed. Then apply one heavy coat of asphalt-base sheet-metal deadener approximately 1/32 inch thick. Special spray equipment, including pressure tank, must be used if deadener is applied by spraying.

b. To exposed body parts, apply air-drying surfacer and color coats in accordance with standard practice.

REPAINTING STEEL PARTS

The foregoing procedures may also be applied to steel and iron parts, with following exceptions:

1. Use of phosphoric-base metal conditioner, such as "Metalprep" (Neilson Chemical Co.) or "Deoxidine" (American Chemical Paint Co.) or equivalent, is recommended in preparing steel for painting. These materials vary in method of application and use, and should be employed only as directed by the manufacturer.

2. Both organic and alkaline paint removers may be used on steel parts. However, if alkaline removers are used, all traces of alkali must be washed off before primer is applied.

3. Oxide-type primer is recommended for use on steel parts, instead of zinc chromate primer. Zinc chromate primer should not be used on steel unless parts have been slightly roughened by sanding.

PAINTING NEW ALUMINUM PARTS

When installing new aluminum parts, or new parts which contact with aluminum parts in assembly, succeeding procedures should be followed:

1. Remove old parts to be replaced.

2. Treat all exposed sides of adjacent parts remaining in body according to instructions in paragraphs 1, 2, 3, and 4 under "Repainting Aluminum Parts" if aluminum; if steel, treat as in paragraphs 1, 2, and 3 under "Repainting Steel Parts."

3. Prime coat all sides of new parts to be installed as outlined in paragraph 4 of "Repainting

Aluminum Parts," and paragraph 3 of "Repainting Steel Parts." Use only zinc or cadmium coated bolts, washers, and nuts. Dip all bolts, nuts, washers, and rivets in primer and allow to dry.

4. Install new parts, then apply finish coats as outlined in paragraph 5 of "Repainting Aluminum Parts."

PAINTING NEW STEEL PARTS

The above procedures may be applied to new steel and iron parts except that oxide base primers are recommended in place of zinc chromate type.

NEW VEHICLES

CAUTION: Vehicles delivered in surfacer, with color coats omitted, should be painted immediately upon receipt of vehicle. Primer and surfacer coats afford little protection against corrosion. Main purpose of primer is to bond succeeding coats to metal while surfacer coat is used only to smooth out any roughness in surface. Both primer and surfacer coats are porous in nature; severe chalking will occur rapidly, with possible flaking during freezing weather, unless vehicle is promptly painted.

Due to deterioration of surfacer, accumulation of road film, etc., while in transit, satisfactory coating and prevention of corrosion can be achieved only by proper preparation.

1. Wash vehicle thoroughly with clear water, using no soaps or chemical cleaners.

2. Thoroughly sandpaper surfacer, using dry paper of light weight grit, preferably 350-400 grade. If vehicle has been in service, it will be necessary to remove virtually all of the original surfacer by sanding.

3. Apply a coating of a good grade of surfacer and allow to dry thoroughly (at least 8 hours; preferably longer). Sand surfacer, using sandpaper of 350-400 grit.

4. Apply color coats in accordance with standard practice.

BODY STRUCTURE

Body and integral underframe are of all-aluminum construction with exception of wood flooring, steel body posts, and steel rear window panel. Underframe and body are built as a unit forming, in effect, a girder-type structure.

Body is composed of underframe, floor, sides, front end, rear end, and roof. Baggage compartments are enclosed by underframe, floor, and sides; inside package racks are supported from upper side body posts. Engine is mounted transversely in rear, supported by roof structure. Some

BODY

details of body construction are shown in figures 1 and 2.

UNDERFRAMING

Body underframe consists of bulkheads, longitudinal members, and aisle side channels. Five aluminum bulkheads and two intermediate fibre-covered plywood panels are used; the latter also serving to partition baggage compartments. Balance of understructure is composed of heavy extruded sections and sheets.

FLOOR

Floor boards are supported by, and attached to, bulkheads, aisle side channels, and floor support angles attached to side panels. Floor boards, of 9/16 inch thick, 5-ply fir, are covered with a vinyl-surfaced, rubber-backed floor covering.

BODY SIDES

Body side is composed of steel posts riveted to bulkheads and floor support angles, to which outer side panels, side mouldings, and rub rails are riveted. Wheel housings are attached to both floor and sides, while baggage doors are hinged to sides.

FRONT END

Front end, which includes driver's compartment, features a two-piece, curved windshield for maximum visibility. Curved left-side front panel, directly below windshield, is of 1/4" thick aluminum, providing additional protection for the driver. Front destination sign, spare tire compartment, and stepwell are also included in front end.

REAR END

Engine is transversely mounted immediately to rear of bulkhead and rear seat back. Engine is supported by rear end structure, which also contains electrical control compartment. Engine and radiator shields are mounted horizontally under engine compartment. Air conditioning evaporator and blowers (when used) are mounted in rear end roof, above rear cross seat.

ROOF

Roof outer panels of aluminum are riveted to steel upper posts and aluminum window panels, and also to front end and rear end structures. Outside air intake grilles are located in roof sides near front of vehicle.

BAGGAGE COMPARTMENT

Three transverse baggage compartments are located under coach floor between front and rear axles. Compartments are accessible through doors on each side of vehicle. Unlatched by wrench, carried in driver's compartment, doors are held

in open position by automatic, telescoping props. Air conditioning unit (if used) is located in left side intermediate compartment.

PACKAGE RACKS

Interior package racks extend along each side of coach above windows. Racks are supported by arms attached to upper side posts. Indirect lighting of coach interior is provided by lights recessed in upper side of package rack support arms.

INTERIOR PANELS

Upper interior trim panels, of vinyl-surfaced masonite, are attached with stainless steel mouldings.

Lower trim panels are vinyl-covered material applied over felt padding. Panels are attached by means of longitudinal stainless steel appearance mouldings.

Interior panels must be removed for access when repairing or replacing exterior panels. Remove interior panels and insulation carefully to avoid necessity for replacement due to damage.

To avoid stripping threads, do not over-tighten self-tapping screws. However, if threads are stripped, use existing holes and employ next larger size self-tapping screws.

EXTERIOR PANELS

When installing an exterior panel, seal all points of juncture with other parts, using a suitable caulking compound, such as that listed under "Special Materials" at end of this section.

Information regarding replacement, riveting, etc., of exterior panels will be found under "Repair and Replacement," later in this section.

INSULATION

Body sides, roof, and posts are thermally insulated by means of fiber glass and pads of cellular insulation between inner and outer panels. Engine compartment is coated with sound deadener compound to prevent entry of engine noise, heat, and fumes into body interior.

REPAIR AND REPLACEMENT**GENERAL**

Body and underframe can be repaired and replaced by competent craftsmen with proper tools and equipment.

In the event of serious collision damage, the Technical Service Department of GMC Truck and Coach Division will furnish dimensional data, sketches, and other information upon request. Reply will be expedited by specific description of damage, and particularly if photographs are furnished.

BODY

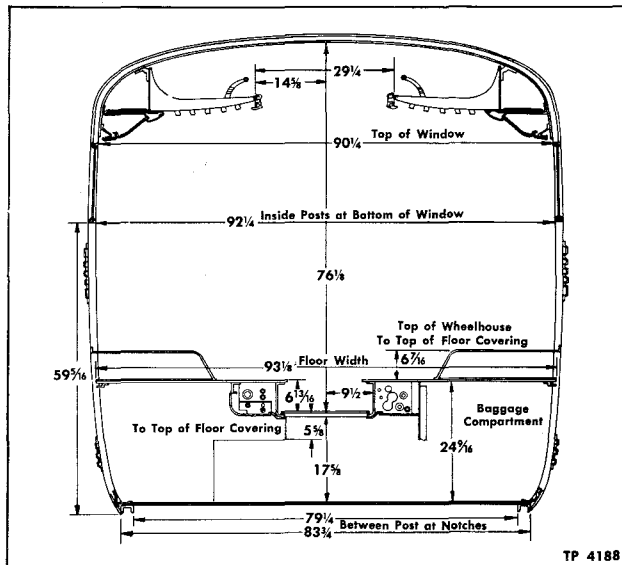


Figure 3—Dimensioned Cross-Section of Body

Meanwhile preliminary work can be started, using dimensions given in figure 3 for checking purposes.

REPLACING BODY PARTS

Whenever repairing or replacing aluminum parts, carefully follow accepted and recommended practices. The Aluminum Company of America will furnish, upon request, booklets titled "Riveting Alcoa Aluminum" and "Welding and Brazing Alcoa Aluminum." The booklets explain detailed procedures necessary in repair and replacement of aluminum parts.

Proper precautions must be observed, particularly with reference to welding, reinforcing, corrosion prevention, and replacement, as follows:

1. Welding of aluminum structural members, or any aluminum parts subject to strain or compression, is not recommended. To maintain proper body strength, replace damaged posts, carlines, and other structural members with new parts obtained from the factory.
2. To prevent galvanic corrosion of aluminum, all surfaces of dissimilar metals in contact with aluminum must be properly coated with paint and/or plating. This also applies to attaching parts such as bolts, washers, nuts, and rivets. Refer to "Repainting Aluminum Parts" and "Painting New Aluminum Parts," earlier in this section.

CAUTION: Avoid mixing steel and aluminum structures or parts when making repairs. Do not substitute steel for aluminum in understructure, rub rails, etc., although steel can be used for support fittings for separate units, such as air tanks,

control rods, etc. Greater deflection (lower modulus) of aluminum causes steel members to tend to take entire load when used in combination with aluminum parts.

STRAIGHTENING

Use of heat when straightening structural parts of body is not recommended, since heat affects structural characteristics of certain alloys and especially heat-treated parts. Body structural members should be straightened cold; any part bent or buckled sufficiently to show strains or cracks after straightening should be replaced, or properly reinforced.

CUTTING

When cutting a structural member, cut at an angle of 30 degrees. Thus, actual length of cut is twice width of piece being cut, and stress or load is distributed over a longer joint when welded. Cutting can be done by torch, although use of saw is preferred, since cut is cleaner and less material is removed.

REINFORCING

CAUTION: Before reinforcing any part of vehicle, determine cause of failure. Body and frame are integral; therefore, driving stresses and strains are transmitted throughout body. Reinforcing a point of apparent failure without correcting underlying cause of failure, may transfer stress to other parts not engineered for such stress, with resultant development of new failures. Since body is designed to "weave," a rigid reinforcement in any part of body may nullify the design of entire vehicle.

Reinforcements can be made of flat, angle or channel stock, whichever is most suitable for purpose. Use of angle reinforcements is recommended due to difficulty in fitting channel reinforcements. Reinforcements should be sufficiently long to distribute load evenly over a considerable area and thickness should not exceed that of member being reinforced. Reinforcements should be riveted to broken part.

RIVETING

Cold aluminum rivets should be used in aluminum parts.

Diameter of rivets should be approximately 100% thickness of plates to be riveted, although rivet diameter is also dependent upon spacing and number used.

Replacement of body parts will necessitate removal of rivets in many cases. Rivets can be removed most easily by cutting off rivet head with

BODY

a sharp chisel, marking center of rivet with a center punch, then drilling out rivet with a drill slightly smaller than body of rivet. Rivet can also be driven out with punch, instead of being drilled out, depending upon type and size of material riveted. If rivet is large, first cut a groove across center of rivet head with a cape chisel before cutting off head with a flat chisel.

WELDING

Refer to note, earlier in this section, regarding welding of structural parts.

Shielded arc welding is recommended as heat of weld is localized and burning of material minimized with this method. When welding a cut member, fill or weld cut completely. Welding rods should be of substantially same material as parts to be welded.

SEALING

When replacing front, side, rear panels, and particularly roof panels, special attention should be given to proper sealing of joints. Use of the sealing and caulking compound, listed at end of this section, is recommended whenever necessary to exclude water, dust, cold, and air.

DINGING AND FINISHING

Paint is quickly scuffed off sharp dents leaving bare metal exposed to corrosion. Importance of proper metal finishing to produce a fairly smooth surface should, therefore, not be underestimated. Application of hammer directly to panel tends to stretch the metal unnecessarily. Whenever possible a spoon should be used when bumping a panel. Repair damaged panels by forcing outward in direction opposite to force which caused damage. In this way metal strains, set up when damage occurred, are relieved.

DOORS AND CONTROLS

Vehicle has two passenger doors -- front entrance and emergency. Both doors are sedan type, hinged at front, and open outward.

FRONT ENTRANCE DOOR

Entrance door is hand-operated type, controlled by door operating mechanism connected between dash and door. Mechanism is so designed that door is locked firmly in either fully open, or fully closed position. Door, however, can be opened from outside vehicle by pressing door release rod knob, located in front panel below windshield.

Door requires little maintenance other than lubrication of hinges and operating mechanism. Mechanism is adjusted by disconnecting door opening rod from door, loosening socket locknut, then turning socket, to shorten or lengthen rod.

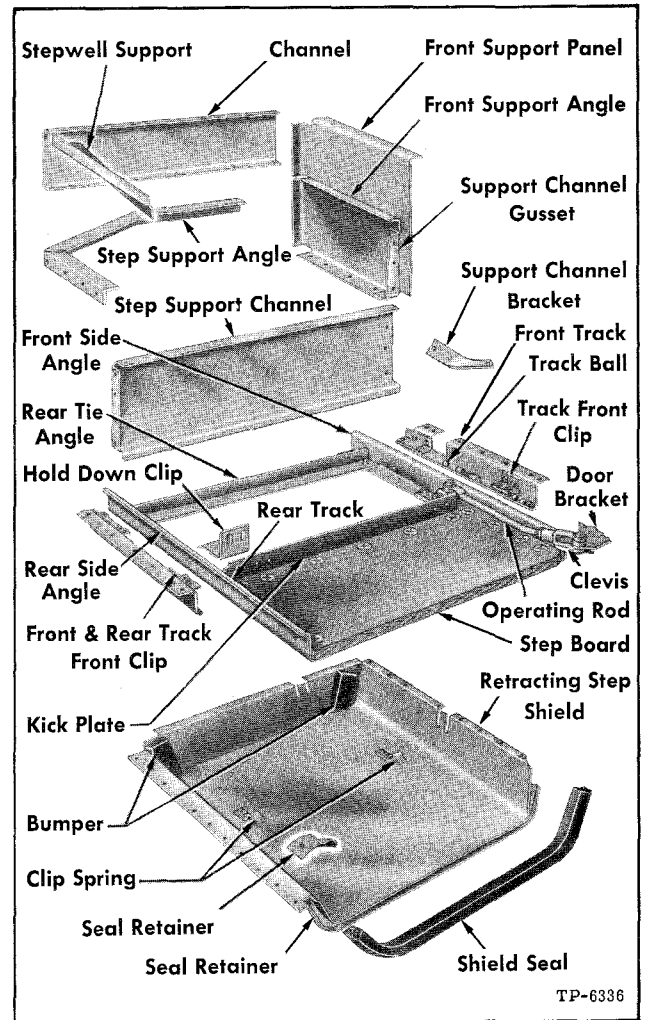


Figure 4—Retracting Step

Whenever door opening rod is adjusted, door opening and closing stop screws should also be adjusted. Properly adjusted mechanism will swing over center and lock door firmly in both fully closed and fully open position. In either position, it should not be possible to move the door unless handle is first moved out of locking position.

Retracting Step (Fig. 4)

Retracting step operates in conjunction with entrance door. Connected to door by operating rod, step slides outward as door is opened. In retracted position, clips on step engage springs on shield to prevent rattling of step.

Retracting step requires no maintenance, other than occasional oiling of clevis pin on operating rod.

When necessary to remove step, remove clevis pin at door. Open door fully; then pull step straight outward from coach. Reach into pan and remove three balls each from forward and reverse tracks.

BODY

Examine tracks and balls carefully for damage; replace parts if wear is evident. Reference should be made to figure 4 for information regarding disassembly of retracting step. Position balls, as illustrated, when assembling step. Lubrication of balls and tracks is unnecessary and undesirable.

EMERGENCY DOOR

Emergency door incorporates an inside bar-type safety lock. Switch, actuated by lock, lights telltale in instrument panel and sounds alarm buzzer to indicate door is not closed or locked. Door should be regularly inspected to make sure of proper operation of door, lock, and telltale. Refer to ELECTRICAL (Sec. 7) for information on alarm buzzer.

Emergency Door Telltale

As a safety precaution, emergency door telltale should be tested daily. Turn engine control switch to "Run" position. Release emergency door latch; telltale should light. If telltale fails to light, proceed as follows:

Ground either No. 4 terminal on body junction panel or No. 61 terminal on control junction panel. If telltale lights, trouble is in switch, or in wiring to switch. If telltale fails to light, trouble is probably due to burned-out bulb, or in wiring.

Emergency Door Switch

Switch is located in door, directly below latch retaining bracket. Emergency door switch requires no maintenance.

SASH AND GLASS

RUBBER INSERT RETAINED GLASS

A special insert-type rubber retainer is used to install glass in windshield, destination sign, rear quarter windows, and rear windows.

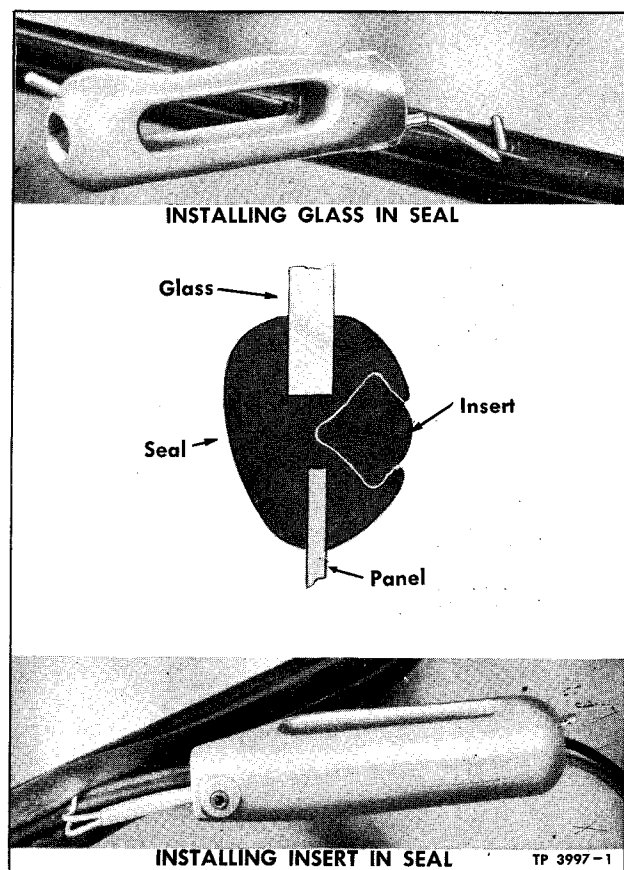


Figure 5—Installing Rubber Insert-Retained Glass

Although possible to install retainer and seal insert without use of special tools, those listed in SPECIAL TOOLS section, at end of manual, are recommended to facilitate installation (fig. 5).

GLASS REMOVAL

1. Raise one end of insert out of groove in retainer seal, with pointed tool; then pull insert from seal by hand.
2. Station an assistant outside vehicle to prevent glass falling; then push glass outward from inside vehicle.
3. Remove rubber retainer seal from panel by hand.

GLASS INSTALLATION

1. Straighten panel flange around opening to assure a good fit in retainer seal groove.
2. Cut new glass to provide following clearance between glass and panel opening on all sides:

LOCATION	CLEARANCE
Front Destination Sign	9/32"
Rear Quarter Window	9/32"
Rear Window	9/32"
Windshield	5/16"
Entrance Door Window	5/16"

3. Position retainer seal in panel cut-out, making sure seal is pushed into place in corners. Ends of seal should come together at side of opening near top.
4. Cut off retainer seal ends, allowing sufficient overlap to secure a tight joint, and carefully butt into position.
5. Apply soap solution to glass groove in retainer seal to facilitate glass installation.
6. Position glass to seal, insert end of re-

BODY

tainer seal installer (fig. 5) in seal groove and move tool along edge of glass forcing outer lip of seal over glass.

7. Thread end of rubber insert through handle and eye of seal installer (fig. 5). At point opposite joint in retainer seal, push tool eye and end of insert into seal groove. Feed into groove in retainer seal. Use a hitching motion to prevent elongation of insert.

8. Cut off insert, allowing overlap, and butt ends tightly into groove.

SIDE WINDOW SASH

Side window sash is equipped with sliding glass shown in figure 6. Window is opened for ventilation by sliding forward half of glass to rear.

EMERGENCY ESCAPE

Side window sash is hinged to body at bottom of sash to provide passenger escape under emergency conditions. Sash is held in closed position by spring-loaded latches at top. A strong push against top of window overcomes latch springs and causes window to swing outward and downward against body side.

CAUTION: Window should be opened in this manner only during an emergency, since damage to body side, sash frame, or glass usually results.

SASH REMOVAL

Entire sash is readily removed after opening window to emergency escape position. Pry small spring-loaded pin from hinge pin with screwdriver. Hold small pin while sliding sash to rear. With hinge pins disengaged, remove sash from coach.

SASH INSTALLATION

Position sash to body; then slide sash forward to engage hinge pins. Swing sash upward into closed position. Make sure emergency escape latches operate properly.

GLASS REMOVAL

1. Remove sash as described earlier under "Sash Removal."
2. Remove two screws which attach vertical end rail to sash; then remove end rail (fig. 6).
3. Remove broken glass and glazing rubber.

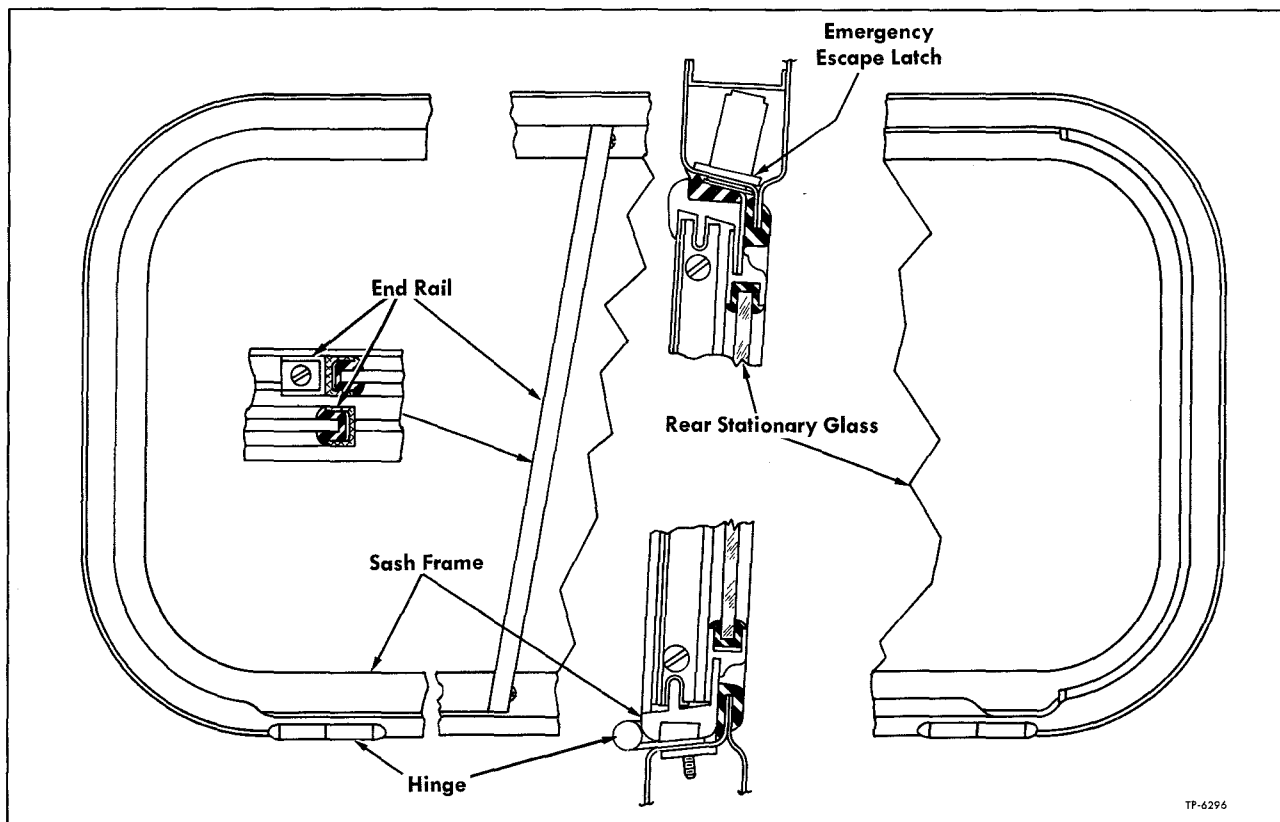


Figure 6—Side Window Sash

BODY

GLASS INSTALLATION

1. Clean frame channels thoroughly.
2. Position new rubber on glass; then install glass with rubber in frame.

3. Install vertical end rail with attaching screws.

4. Install sash in body, as described earlier under "Sash Installation."

MISCELLANEOUS EQUIPMENT

WINDSHIELD WIPERS

Two air-operated windshield wipers are mounted in front panels, below windshield. Air pressure for wiper operation is supplied by auxiliary air system, fed, in turn, from vehicle air system. A pressure regulating valve, interposed in air lines, prevents depletion of main air system by shutting off air to auxiliary air system when pressure in main system falls below approximately 65 pounds.

Windshield wiper motors are individually controlled by adjustable valves, mounted on driver's partition below right side of switch panel.

Refer to AIR BRAKES (SEC. 4) for air line diagrams and information on air lines and connections, including maintenance and repair information on pressure regulating valve.

CONTROL VALVE (Fig. 7)

Windshield wiper control valve is fitted with an adjustable "stop-knob," which prevents opening valve beyond a predetermined point. Purpose is to prevent operation of wiper at excessive speed, with resultant rapid wear of motor.

To adjust knob, loosen two set screws and pull knob off regulator sleeve. Adjust knurled regulator sleeve to provide proper motor speed, on windshield kept thoroughly wetted. Maximum speed should not exceed 60 complete cycles (120 strokes) per minute. Position stop-knob on regulator sleeve, using care to avoid disturbing adjustment. While pressing knob against body, tighten knob set screws firmly. Properly adjusted

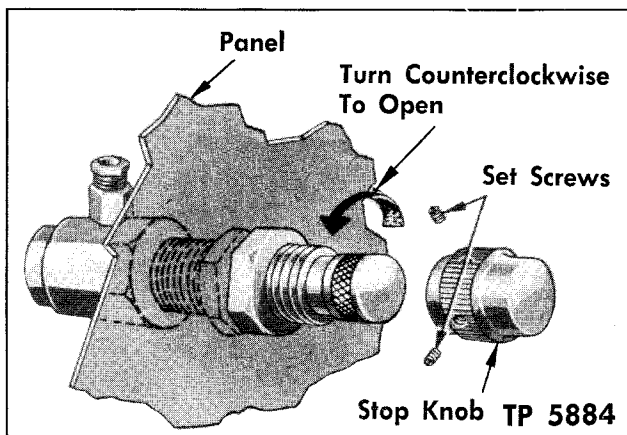


Figure 7—Windshield Wiper Control Adjustment

knob will "bottom" on valve body, with wipers operating at maximum desired speed

MAINTENANCE

Windshield wiper motors are designed to require no special maintenance and should remain undisturbed unless motors fail to function. Before replacing motors, check all tubing, connections, and control valves for leaks or plugging.

A special type blade is used to properly clean curved windshield surface; use same type for replacement.

AIR HORNS

Dual air horns are mounted on bracket located in horn compartment. Horns are accessible from underneath left front corner of coach. Air pressure to horns is controlled by driver's foot control valve. Air pressure is supplied by auxiliary air system, obtained in turn, from main air system. Pressure regulating valve in air lines prevents depletion of main air system by shutting off air to auxiliary air system when pressure in main system falls below approximately 65 pounds.

Refer to AIR BRAKES (SEC. 4) for air line diagrams and information on air lines and connections. Pressure regulating valve maintenance and repair information is also contained in that section.

REPAIR

Sound is produced by stainless steel reed vibrating between two seats. Seats are separated 1/32", this spacing being maintained by a gasket.

Horn is non-adjustable, and requires no maintenance.

In the event of horn failure, make sure that air system pressure is at least 75 lbs. Sticking reed may be cause of failure; usually reed can be freed without removing horn from vehicle. Tap reed through back opening of horn while assistant operates driver's foot control valve intermittently. If this fails to free reed, removal and disassembly of horn is necessary. Seats can be cleaned with a flat oil stone. Since reeds act as air valves, reeds must be flat. If not flat, replace reeds.

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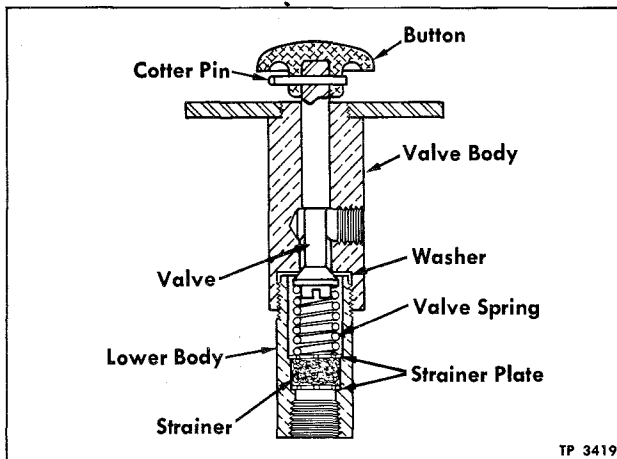


Figure 8—Air Horn Foot Valve

FOOT CONTROL VALVE

Valve, which controls operation of air horns, is mounted in driver's floor, with valve body extending downward into tool compartment (fig. 8). Valve requires no maintenance, but can be easily checked for leakage with soap and water solution.

If leakage does occur, valve should be disassembled and lapped, using fine valve grinding compound. After grinding, wash all parts in gasoline and blow with compressed air to remove all traces of grinding compound.

Whenever valve is disassembled, or in event of weak horn action, curled hair strainer in lower body should be cleaned. Lower body is threaded into valve body, and is removed by unscrewing.

PASSENGER SIGNAL CHIME

Passenger signal chime (fig. 9) is mounted on driver's compartment front trim panel, directly forward of driver. Chime is sounded by two switches, mounted under front ends of package racks. Switches are operated by pull cords at top of side

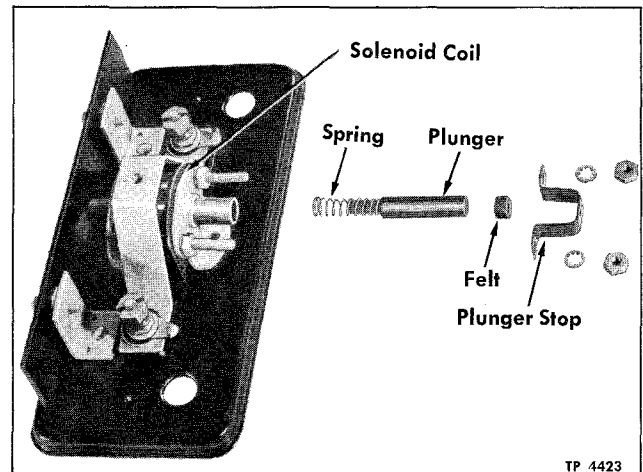


Figure 9—Passenger Signal Chime

windows. Chime circuit, fed through "RUN" position of engine control switch, is shown on "Alarm and Signal Wiring Diagram," at back of manual.

MAINTENANCE

Solenoid-type chime has no contacts and requires no regular maintenance.

If chime fails to operate with either switch, remove cover, which is attached with a single screw. With engine control switch in "RUN" position, check for current indication at both terminals of chime. Current should be obtained at one terminal. Ground other (dead) terminal with jumper wire.

If chime now sounds, check circuit continuity from chime, through switches, to ground. If chime does not sound, make sure plunger operates freely. Disassemble chime as shown in figure 9. Failure may be due to burned out coil, or may be caused by felt positioned in such manner as to prevent operation of plunger.

Chime switches require no maintenance; however, snap-on cover is easily removable for inspection and cleaning of contacts.

HEATING AND VENTILATION

Information contained herein applies only to the standard GM Heating and Ventilation System, and does not include information on any special equipment except for mention of operation of fresh air blowers in conjunction with the GM Air Conditioning System.

HEATING SYSTEM

DESCRIPTION

Interior of coach is heated by an under-floor, hot water, forced air heating system which is

entirely automatic except for manually operated on and off switch on control panel at left of driver. Hot water is supplied to heater cores by the engine cooling system. Heating system comprises the following units (fig 10):

Two insulated hot air ducts, which extend from front to rear of coach through top of baggage compartments on either side of recessed center aisle, with hot air outlets through floor under seats.

Two heater cores, blowers, and motors located under floor in top of forward baggage compartment.

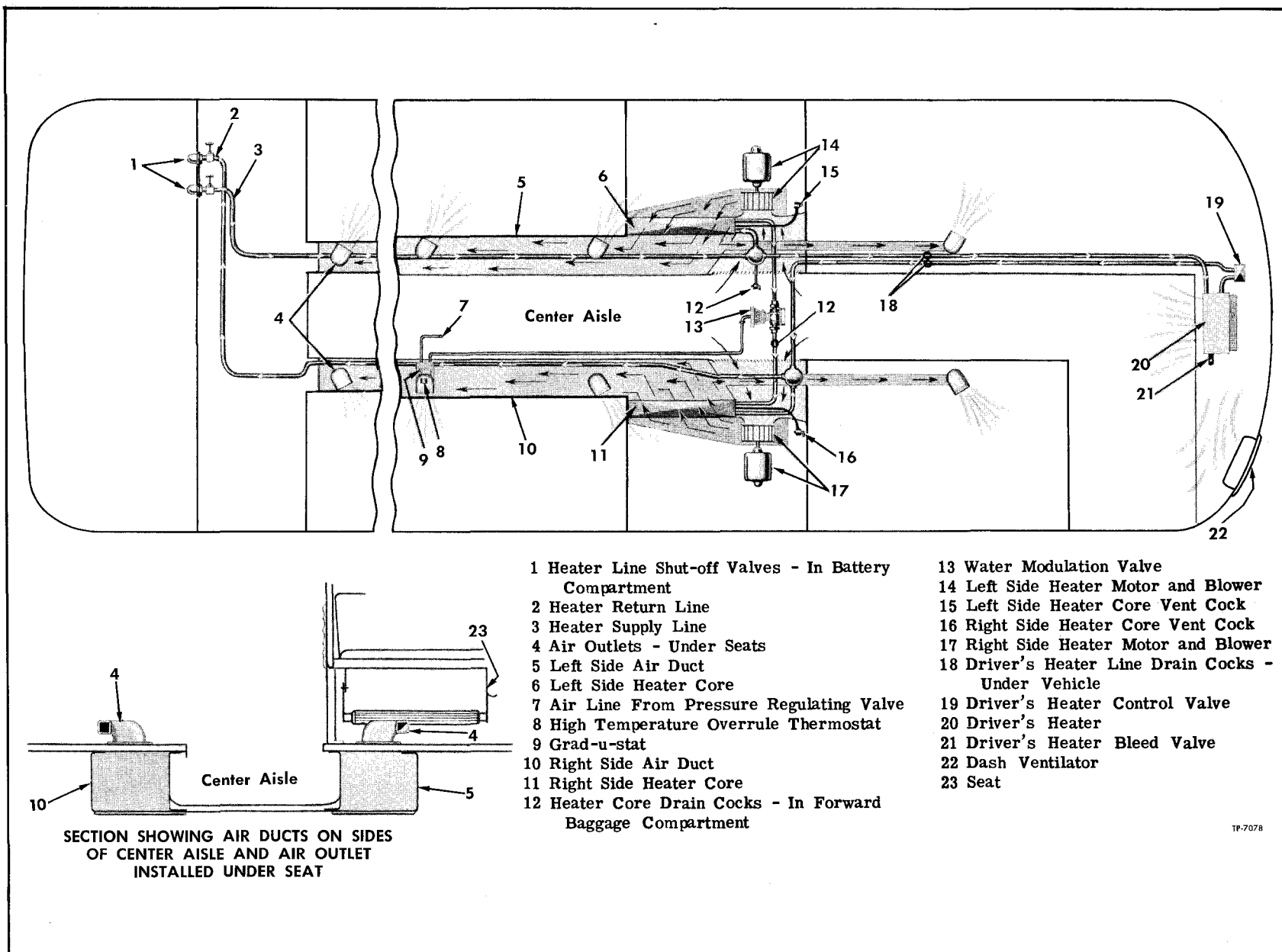


Figure 10—Schematic Layout of Heater Pipes, Hot Air Ducts, and Controls

BODY

Water modulation valve, connected into heater lines and mounted in top of forward baggage compartment between heater blowers.

High temperature overrule thermostat and water modulation valve Grad-U-Stat (thermostatically operated air pressure control valve) which are mounted on floor under fourth seat from front on right-hand side.

Driver's heater, located behind grille in center of dash panel, which includes a heater core, blower, and a manually adjusted thermostatic control valve.

Two windshield defroster blowers, located below windshield ledge.

Heating switch and driver's heater rheostat switch, located on control panel at left of driver, and defroster switch located on switch panel in front of driver.

Two heater motor magnetic switches and two automatic reset type circuit breakers, mounted in forward baggage compartment between heater blowers.

Hot water supply and return pipes, shut-off valves, and electrical wiring.

OPERATION**Water Circulation (Fig. 10)**

Hot water from the engine cooling system is forced through the heater supply line by the engine water pump. Actual flow of water through the under floor heater cores is controlled by the modulation valve, and flow of water through the driver's heater core is controlled by the manually adjusted thermostatic control valve. Water modulation valve is air-operated, the air pressure delivered to it being graduated by the Grad-U-Stat, which is sensitive to inside coach temperature. After circulating through heater cores, water flows through the return line to the suction side of the engine water pump. Two gate valves, one in supply line and one in return line, provide means of isolating the heating system from the engine cooling system for summer operation, or to permit working on either system without draining the other. Valves are located in battery compartment.

Air Circulation (Fig. 10)

Under floor heater blowers run continuously at constant speed when "HEATING" switch is turned on. Blowers draw air through grilles in aisle side risers and force it through heater cores into the hot air ducts. Hot air outlet under each double seat, except second seat from front on each side, directs hot air outward and toward front of vehicle. If for any reason inside coach temperature continues to rise above normal thermostat setting, high temperature overrule thermostat will open at 85°F, breaking circuit and stopping heater blower motors. Air forced through under floor heater

cores is entirely recirculated air, these heaters having no outside air intake; air forced through driver's heater core may be all recirculated air or part outside air as desired through manual positioning of dash ventilator. Driver's heater fan speed is controlled by "DRIVER'S HEATER" rheostat switch on control panel at left of driver. Refer to "Heating and Ventilation Wiring Diagram" in back of manual for wiring circuits.

MAINTENANCE**General**

1. Two oil cups are provided at each under floor heater motor, accessible inside of front baggage compartment, and one oil cup on extension tube, accessible through dash safety compartment, provides means of lubricating driver's heater fan. These points should be lubricated periodically, referring to LUBRICATION (SEC. 13) for recommended intervals and type of lubricant.

2. Heating system should be flushed semi-annually, following same general procedure described for flushing engine cooling system in "COOLING SYSTEM - GENERAL" (SEC. 6).

3. At beginning of heating season, examine heater pipe joints and fittings, and heater cores for leakage and make the necessary repairs. Clean all dirt from heater cores.

4. Check for proper operation of heater motors, thermostat, Grad-U-Stat, water modulation valve, and magnetic switches at beginning of each heating season.

5. Drain cock is provided for draining moisture from Grad-U-Stat and pressure regulating valve air lines. Drain cock, located in forward baggage compartment, should be opened at regular intervals to eject moisture.

Draining (Fig. 10)

1. If heating system is to be drained without draining engine cooling system, close two gate valves in battery compartment.

2. Open vent cocks on under floor heater cores; vent cocks are installed on extension tubes in front baggage compartment, one at each side of vehicle.

3. Open two drain cocks in front baggage compartment, providing suitable container to catch drainage. One drain cock is located in bottom of heater supply pipe, just to right of water modulation valve; the other drain cock is installed on extension tube at left of water modulation valve.

4. Open two drain cocks in driver's heater lines, located under vehicle near left front spring just rearward of front axle.

Bleeding (Fig. 10)

Whenever engine cooling and coach heating system has been drained and refilled, when system

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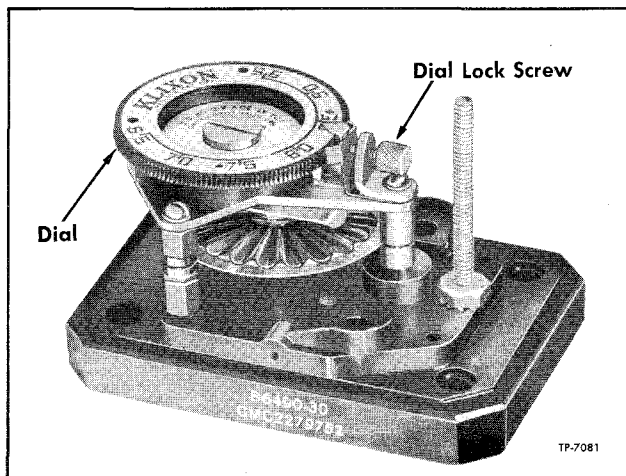


Figure 11—High Temperature Overrule
Thermostat With Cover Removed

has run low and water is replenished, or whenever sufficient air has accumulated in system to retard normal flow of water, heating system should be bled to expell air.

1. Make sure all drain and vent cocks are closed and that gate valves, located in battery compartment, are open.

2. Fill cooling system as directed in "COOLING SYSTEM - GENERAL" (SEC. 6). With engine running at half throttle, bleed air from system as follows:

- a. Open vent cock in left side of forward baggage compartment; close vent cock when all air is expelled.

- b. Turn driver's heater control valve knob clockwise to extreme open position. Press down on bleed valve button, accessible through dash safety compartment; release button when all air is expelled.

- c. Open vent cock in right side of forward baggage compartment; close vent cock when all air is expelled.

3. Slow engine down to normal idle and replenish engine cooling system if required,

HIGH TEMPERATURE OVERRULE THERMOSTAT

High temperature overrule thermostat (fig. 11) is mounted inside of cover which is attached to hot air outlet under fourth seat from front on right-hand side. Thermostat contacts are normally closed, completing circuit through both heater motor magnetic switch windings; when temperature in coach rises to temperature at which the thermostat dial is set, contacts open and break the circuit through the heater motor magnetic switches.

Thermostat has an adjustable dial which may be set for any temperature at which the contacts open. While dial is set at the factory at 85°F, this setting may be raised or lowered as desired. Dial is locked in position by a lock and lock screw

(fig. 11). Cover retaining screw is secured with a wire and lead seal to prevent unauthorized personnel tampering with the dial adjustment. Wire and seal should be replaced after adjustment is made.

Thermostat is not reparable in the field and, except for the manual dial, is non-adjustable. Sealed silver contacts require no cleaning and should operate indefinitely.

CAUTION: Any attempt to adjust (other than by dial) or repair thermostat will undoubtedly destroy the calibration of the unit. Should this occur, thermostat must be replaced with a new or factory recalibrated unit.

Thermostat Removal

1. Break lead seal and remove lock wire from knurled nut which retains thermostat cover. Remove knurled nut and cover.

2. Remove four screws, nuts, and lock washers which attach thermostat and spacers to heat outlet cover, then remove thermostat and spacers.

3. Disconnect wires from thermostat terminals to complete removal.

Thermostat Installation

1. Connect wires to thermostat terminal numbers 1 and 3.

2. Position thermostat on inside of heat outlet cover, using spacers between thermostat base and cover, and attach with four screws, lock washers, and nuts.

3. Loosen dial lock screw, set dial at desired temperature (85°F recommended), and tighten dial lock screw. Install thermostat cover and secure with knurled nut, then install lock wire and lead seal in knurled nut.

GRAD-U-STAT

Operation (Fig. 12)

Grad-U-Stat is installed on top of coach floor adjacent to heat outlet under fourth seat from front on right-hand side. Two air lines connect to Grad-U-Stat. Main air line, connected to port marked "M," is the feed line, carrying air pressure to the Grad-U-Stat from the air pressure regulating valve, which limits the air pressure to 17 pounds; branch air line, connected to port marked "B," carries air pressure from the Grad-U-Stat to the water modulation valve.

Vapor filled bellows in Grad-U-Stat is sensitive to inside coach temperature. Expansion and contraction of bellows, caused by increasing and decreasing coach temperatures, is transmitted to air control valves in lower portion of unit through levers. As temperature in coach rises, bellows expands and exerts downward force on secondary

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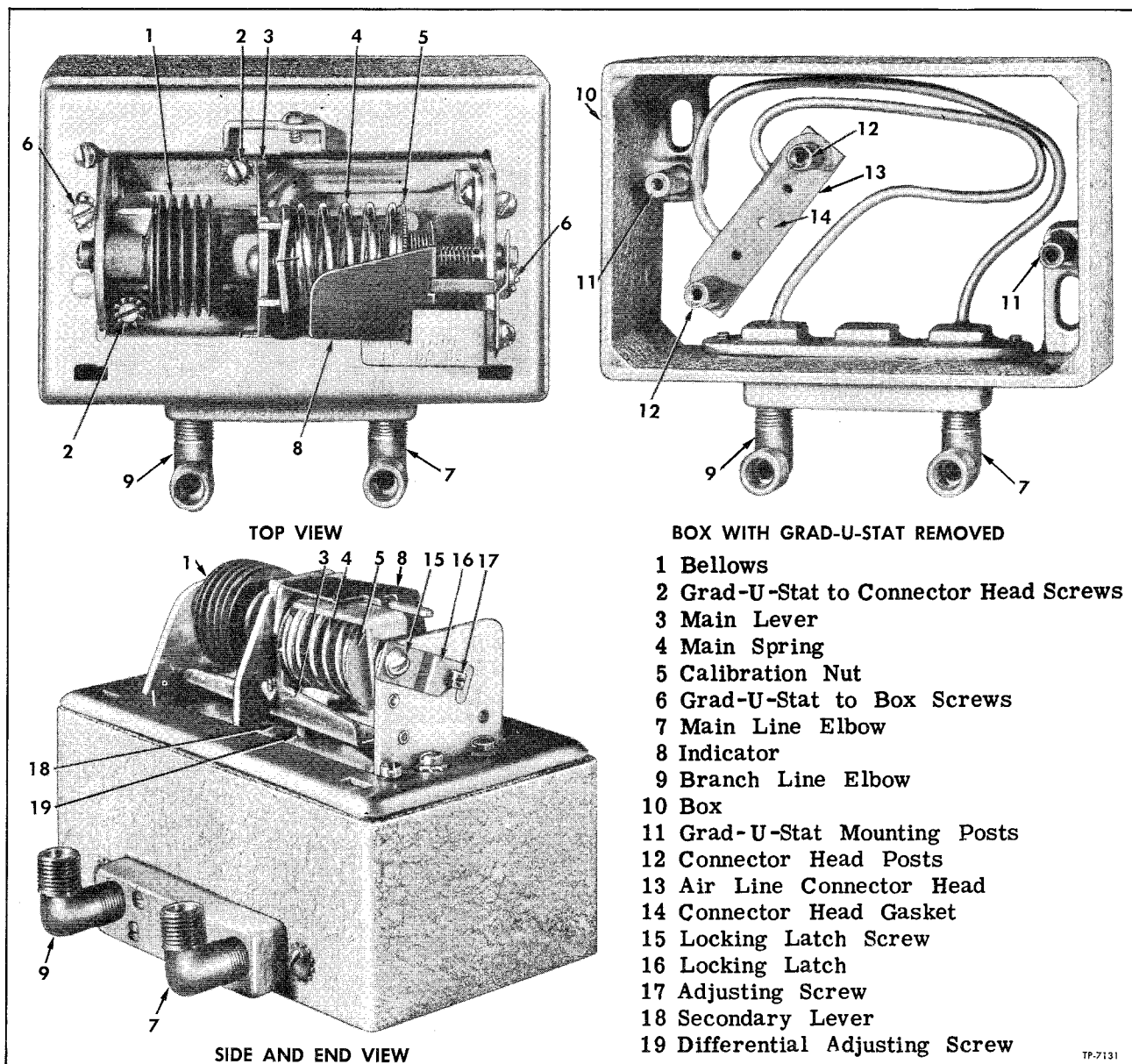


Figure 12—Heating System Grad-U-Stat

lever through main lever and adjusting button. Downward movement of secondary lever is transmitted to a lever in the air control portion of the unit, increasing the air pressure delivered to the water modulation valve. This increased air pressure at the modulation valve causes the valve to reduce the flow of water through the heater cores. When temperature in coach lowers, the bellows contracts and relieves pressure exerted on air control valve lever. Air control valve then exhausts air pressure from the water modulation valve, increasing the flow of water through the heater cores.

The air pressure delivered by the Grad-U-Stat

varies in proportion to the inside coach temperature acting upon the bellows; thus, flow of water through the under floor heater cores is graduated as required in accordance with inside coach temperature.

The adjusting button in the secondary lever is set at the factory to provide a 4°F differential between fully closed and fully opened position. This setting has been found satisfactory for most operations and it is recommended that it not be changed.

Test and Adjustment (Fig. 12)

1. Remove four screws and special nuts

BODY

attaching cover to heat outlet. Cover, with thermostat installed, can be set on end without disconnecting wires from thermostat to permit access to Grad-U-Stat.

2. Exhaust air pressure from air system. Disconnect air line from port marked "B." This is the line leading to the water modulation valve. Connect an air pressure test gauge to this port. Build up air pressure in air system.

3. Check the air temperature at the bellows with an accurate thermometer.

CAUTION: Do not touch the thermometer bulb or the bellows with hand while accomplishing the following operations, as body heat will affect both units and erroneous readings and adjustments will be obtained.

4. Loosen locking latch screw, disengage latch from adjusting screw, then turn the adjusting screw to set the indicator at the temperature shown on the thermometer.

5. Observe pressure reading on air pressure test gauge. If pressure reading is 7-1/2 pounds, no adjustment is required. If pressure is above 7-1/2 pounds, turn the calibration nut and main spring to shorten the spring until the correct reading (7-1/2 pounds) is obtained. If pressure is below 7-1/2 pounds, turn calibration nut and main spring to lengthen the spring.

6. After correct adjustment is obtained, remove gauge and reconnect air line to "B" port. Turn adjusting screw to set the indicator at desired operating temperature (75° F is factory setting), place locking latch over adjusting screw, and tighten latch screw.

7. Position heat outlet cover on outlet and attach with four screws and special nuts.

Grad-U-Stat Removal (Fig. 12)

1. Remove four screws and special nuts attaching cover to heat outlet. Cover, with overrule thermostat installed, may then be set on end without disconnecting wires from thermostat to permit access to Grad-U-Stat.

2. Exhaust air pressure from air system.

3. Remove center screw at each end of unit attaching mounting plate to Grad-U-Stat box. Remove two screws attaching air line connector head to Grad-U-Stat; one screw is located on either side and at opposite ends of bellows, accessible from the top. Lift Grad-U-Stat assembly out of box.

4. If necessary to remove Grad-U-Stat box, which includes air lines and connector head, disconnect air lines from elbows at side of box, then remove two screws attaching box to floor.

Grad-U-Stat Installation (Fig. 12)

1. If new Grad-U-Stat box is being installed,

install elbows in air ports and tighten firmly; leave both elbows pointing up after final tightening.

2. Position box on floor and attach with two screws. If box is new, remove screw and spacer from each connector head post, then remove connector head protector. Make sure gasket on connector head is in good condition.

3. Position Grad-U-Stat in box, with the two small holes in bottom of air control valve registered with holes in air line connector head gasket. Insert two screws, with toothed lock washers, down through frame and thread into connector head posts. Tighten screws firmly. Insert screw, with toothed lock washer, down through each end of mounting plate and thread into posts in box.

4. Connect main air line to elbow in port marked "M." Connect air pressure test gauge to port marked "B." Build up air pressure in air system.

5. Test Grad-U-Stat operation, and adjust if necessary, and complete the installation as previously directed in steps 3 through 7 under "Test and Adjustment."

WATER MODULATION VALVE

Water modulation valve (fig 13) is an air-operated water control valve installed in heater line leading from left-hand under floor heater core to right-hand heater core (fig 10). Modulation valve controls the flow of hot water through the heater cores in accordance with the air pressure delivered to it by the Grad-U-Stat. Operation of Grad-U-Stat is described previously. Modulation valve is mounted on under side of aisle floor in forward baggage compartment, and is secured to mounting bracket with two U-bolts and a mounting clamp.

Modulation Valve Removal

1. Exhaust air pressure from air system. Disconnect air line from modulation valve.

2. Drain heating system as previously directed under "Draining."

3. Disconnect water line from each side of valve.

4. Remove nuts and lock washers from two U-bolts securing valve to mounting bracket, remove U-bolts and mounting clamp, then remove modulation valve assembly.

Modulation Valve Disassembly (Fig. 13)

1. Loosen set screw securing bellows spider to valve bonnet. Separate spider from bonnet, then lift spider and bellows assembly off over valve stem and spring. Remove screws attaching cover to spider and remove cover and bellows assembly.

2. Unscrew bonnet from valve body, then remove bonnet, valve, and stem assembly from valve body.

BODY

3. Remove retainer ring and pin securing valve on valve stem, then remove valve assembly, bonnet and packing assembly, spring, and washers from valve stem.

Inspection and Repair (Fig. 13)

1. Examine valve seat in valve body. Remove all corrosion or other foreign deposits from seat with fine steel wool. If seat is badly pitted or otherwise damaged, replace valve body.

2. Examine valve seal on valve assembly. If deeply grooved or deteriorated, unscrew seal retainer and remove seal. Install new seal and secure with seal retainer. Tighten retainer firmly against seal, but not sufficiently to distort seal.

3. Whenever valve is disassembled, packing should be replaced in valve bonnet. Remove packing retainer, spring, and packing from bonnet. Install new packing, install packing spring and retainer, and tighten retainer sufficiently to partially compress spring.

4. Examine valve stem for wear or corrosion where it passes through packing in valve bonnet. Smooth up or replace valve stem as necessary.

5. Examine bellows for cracks or distortion. If leakage is suspected, connect air line to bellows and apply a maximum of 15 pounds pressure with bellows immersed in water. If leakage is evident, unscrew bellows from cover and install new bellows on cover.

Modulation Valve Assembly (Fig. 13)

1. Assemble the following parts on valve stem in the order named: Small washer, valve spring, small washer, large washer, and bonnet assembly. Place valve retainer ring over valve stem, install valve assembly on valve stem and secure with pin, then place retainer ring over top of valve and stake into groove in valve to retain pin.

2. Assemble valve, bonnet, and stem assembly to valve body, inserting valve into body and threading bonnet into body. Tighten bonnet firmly.

3. Assemble bellows and cover to spider and attach with screws. Install spider assembly on valve bonnet and tighten retaining set screw firmly.

Modulation Valve Installation

1. Arrow on valve body indicates direction of flow through valve. Valve must be installed to permit flow of water from left-hand heater core to right-hand heater core; in other words, the arrow must point toward the right-hand side of the coach.

2. Position valve at mounting bracket and secure with mounting clamp and two U-bolts. Tighten U-bolt nuts firmly.

3. Connect water line to each side of valve, using sealing compound sparingly on threads.

4. Connect air line to cover.

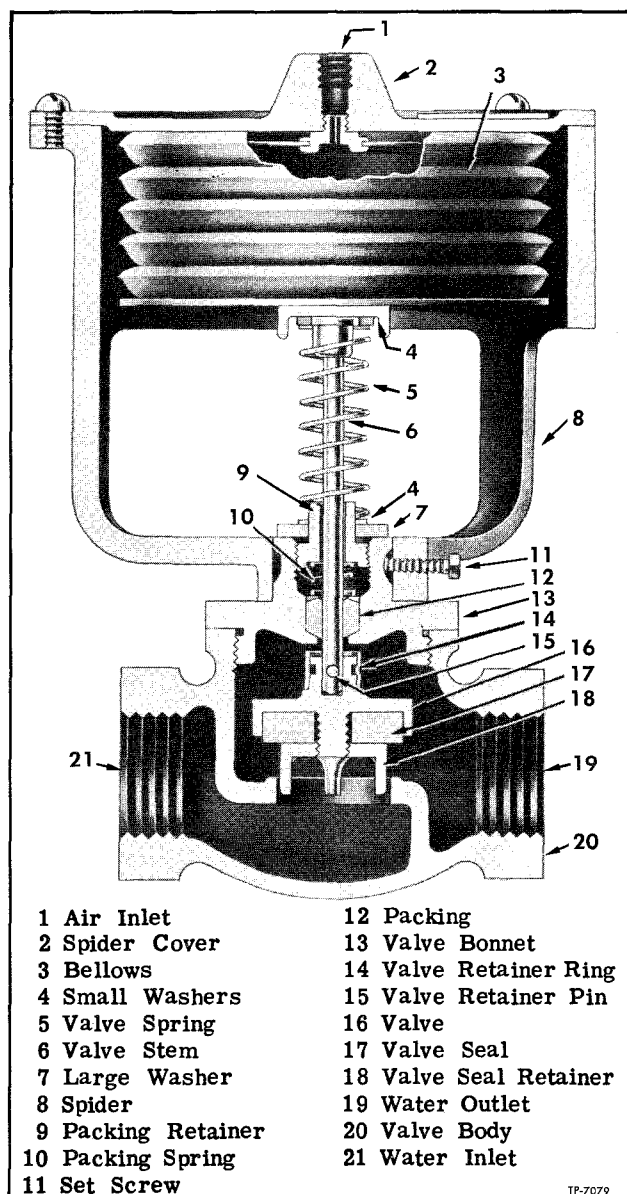


Figure 13—Water Modulation Valve

AIR PRESSURE REGULATING VALVE (Fig. 14)

Air pressure regulating valve is mounted on under side of aisle floor at center of forward baggage compartment. Valve regulates air pressure delivered to Grad-U-Stat, limiting the pressure to 17 pounds. Compressed air from air tank passes through the regulating valve into the outlet line leading to the Grad-U-Stat. When pressure in outlet line reaches 17 pounds, air pressure under diaphragm overcomes spring pressure above diaphragm and deflects diaphragm upward. Upward movement of diaphragm removes pressure from valve. Valve spring forces valve up against seat, preventing further passage of compressed air into the outlet line. As the Grad-U-Stat uses the com-

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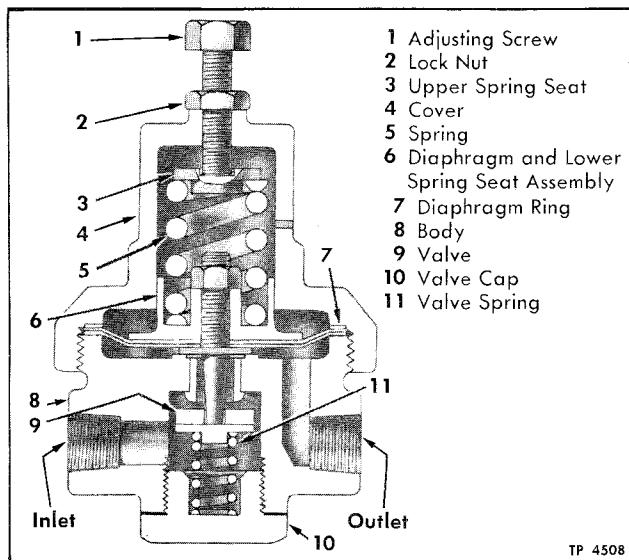


Figure 14—Air Pressure Regulating Valve

pressed air, the regulator valve admits additional compressed air, thus maintaining a constant pressure of 17 pounds at the Grad-U-Stat.

Regulating Valve Adjustment (Fig. 14)

1. Exhaust air pressure from air system. Disconnect air line from regulating valve outlet port and connect an air pressure test gauge to this port.
2. Build up air pressure in air system and observe reading on air pressure test gauge. If below or above 17 pounds, adjustment is required.
3. If pressure is above 17 pounds, back adjusting screw out a few turns, then loosen gauge connection to bleed pressure down below 17 pounds.
4. Gradually turn adjusting screw inward until gauge registers 17 pounds, then tighten adjusting screw lock nut.
5. After maximum pressure (17 lbs) is reached, gauge should show no further increase. If pressure gradually increases, valve is not seating properly due to worn valve or dirt on valve or seat. Apply soap suds to vent hole in valve cover. If bubbles appear, diaphragm is leaking and must be replaced.

Regulating Valve Disassembly (Fig. 14)

1. Remove adjusting screw (1) and lock nut (2).
2. Unscrew cover (4) from body (8). Remove spring, spring seats, diaphragm, and diaphragm ring from body.
3. Unscrew valve cap (10) from valve body (8) and remove valve (9) and spring (11).
4. Clean metal parts in suitable solvent and wipe dry. Wipe diaphragm and valve clean with cloth dampened with cleaning solution.
5. Inspect diaphragm carefully. If cracked or

deteriorated, unscrew nut from diaphragm rod. Unscrew lower spring seat from diaphragm rod and remove diaphragm. Install new diaphragm on rod, with smooth side toward tapered end of rod. Install lower spring seat and nut on rod, tighten each firmly.

Regulating Valve Assembly (Fig. 14)

1. Insert valve (9) into body (8) with rubber seat in valve against seat in body. Install valve spring (11) and valve cap (10).
2. Place diaphragm with lower spring seat (6) on body with tapered end of diaphragm rod seated in center of valve (9). Place diaphragm ring (7) on top of diaphragm. Position spring (5) in lower spring seat, with upper spring seat (3) on top of spring.
3. Carefully place valve cover (4) over spring (5) and thread cover onto body (8). Tighten firmly.
4. Thread adjusting screw (1) into cover, install valve in vehicle, and adjust pressure setting to 17 pounds as directed under "Regulating Valve Adjustment."

NOTE: When connecting air lines, apply aviation type permatex to male threads, but DO NOT COAT FIRST TWO THREADS.

UNDER FLOOR HEATER CORES, BLOWERS, AND MOTORS

Heater cores, blowers, and motors are suspended from coach floor in top of forward baggage compartment, one on either side of aisle. Right-hand motor and blower wheel rotate counterclockwise and left-hand motor and blower wheel rotate clockwise, each blower forcing air through its respective heater core into the air duct. Each motor is secured to support bracket by four rubber bushed mountings. Each blower wheel is secured to its motor shaft by two hollow head set screws. Blower wheels and heater cores are inclosed by shells which direct the air flow through the heater cores into the air ducts. All joints in blower and heater core enclosures are sealed. Water line connections at heater cores are made through bolted flange type connectors. Motors can be disassembled, brushes replaced, and commutator turned and undercut in accordance with established practice. Do not turn commutator more than necessary to obtain smooth surface. Motor bearings should be lubricated at intervals specified in LUBRICATION (SEC. 13).

MAGNETIC SWITCHES AND CIRCUIT BREAKERS.

Under floor heater motor magnetic switches and circuit breakers are mounted on rear side of front spring rear bulkhead, and are accessible in forward baggage compartment. Magnetic switch windings are connected in series with the high

BODY

temperature overrule thermostat and the "HEATING" switch on control panel at left of driver. When "HEATING" switch is turned on, circuit through magnetic switch windings is completed, causing magnetic switch contacts to close. With magnetic switch contacts closed, circuit is completed to heater motors direct from battery junction. One 30 amp automatic reset type circuit breaker is connected in series in each circuit from magnetic switches to motors. Circuit from "HEATING" switch to magnetic switch windings is protected by Number 18 circuit breaker on circuit breaker panel at left of driver.

Magnetic switches are sealed units and are not adjustable or reparable. If either switch fails to operate, it must be replaced. Before replacing switch, check circuit continuity through circuit breaker to make sure the trouble is in the switch and not in the circuit breaker.

DRIVER'S HEATER (FIG. 10)

Driver's heater unit, consisting of a heater core, motor, and a belt driven fan, is installed in center of dash compartment. Push button type bleed valve is located in top of heater core outlet pipe at upper right-hand corner of core. Flow of water through heater core is modulated by regulator valve connected in heater core outlet line. Regulator valve is mounted on side of dash compartment panel at right of driver. Regulator valve capillary tube samples air in coach, causing valve to reduce or shut off flow of water as coach temperature rises to the desired setting.

Manual adjustment of regulator valve is provided by a knob installed on valve shaft. Turning knob clockwise raises regulator setting, and complete clockwise rotation (past detent pressure) holds valve fully open, regardless of coach temperature. Turning knob counterclockwise lowers regulator setting, and complete counterclockwise rotation holds valve closed, regardless of coach temperature.

Air forced through heater core may be all recirculated air, taken in through dash compartment grilled door, or part outside air taken in through dash ventilator. Dash ventilator may be opened or closed by driver by turning ventilator control knob, accessible inside dash compartment. Speed of heater fan is controlled by "DRIVER'S HEATER" rheostat switch on control panel at left of driver.

Heater unit mounting bolts are accessible after opening dash compartment door, and after removing front license plate holder from outside vehicle. Heater water line connections are also accessible through front license plate holder opening.

WINDSHIELD DEFROSTERS

Dual windshield defroster blowers are mounted under windshield ledge. Motors are non-reparable

type, and should be replaced in event of failure.

Defroster blowers are controlled by three-position "DEFROSTER" switch on switch panel in front of driver. Defroster motor circuit is protected by number 19 circuit breaker on circuit breaker panel at left of driver.

VENTILATION

Outside air can be admitted to coach through adjustable dash ventilator in front panel, through hinged section of driver's window and front entrance door window, and through sliding half of each side window sash.

In addition, two motor driven outside air blowers, mounted in roof at forward end of each package rack, draw in outside air and force it through ducts into interior of coach. With all other openings closed, blowers slightly pressurize coach interior, thereby serving to exclude unconditioned, air, dust, fumes, and moisture from coach. Air is exhausted from coach through louvered opening in bottom of entrance door.

DASH VENTILATOR

Dash ventilator requires little maintenance except for periodic inspection of seal and screen. Open ventilator and inspect seal from outside coach. Visual inspection should disclose defective seal; however, seal can be effectively tested with a water hose. Replace defective seal, using a good grade of cement for attachment. Inset in figure 1 illustrates ventilator, seal, and control knob installation. Clean screen with compressed air, blowing air outward from inside vehicle.

OUTSIDE AIR BLOWERS

Blower and motor is mounted inside housing at front end of each package rack. Intake grilles on sides of roof admit air which blowers force rearward through ducts. Air flow reverses in compartment in rear end of roof, flowing forward through distributing ducts. Slots in ducts above side windows distribute air to interior of coach. When coach is equipped with air conditioning, compartment at rear end of roof houses the cooling evaporator, which dehumidifies and cools the air.

Blower Operation

Blowers are controlled by rheostat type "BLOWER" switch on control panel at left of driver. Switch permits driver to shut off blowers or vary blower speed as desired. However, when air conditioning is used, blowers operate constantly at full speed when "MASTER SWITCH" is in "COOLING" position, and "BLOWER" switch is inoperative.

Blower circuit, fed through "RUN" position of diesel "CONTROL" switch, energizes blower relay.

BODY

Energized relay feeds current from battery circuit to "BLOWER" switch. Rheostat type "BLOWER" switch is then used to vary speed of blowers or to stop blowers as desired. When coach is equipped with air conditioning, blower circuit is fed through air conditioning "MASTER SWITCH". With "MASTER SWITCH" in "HEATING" position, current flows directly from battery circuit through "BLOWER" switch to blowers; "BLOWER" switch can then be used to vary blower speed or stop blowers as desired. With "MASTER SWITCH" in "COOLING" position, blower relay is energized; relay feeds current directly to blowers, by-passing the "BLOWER" switch, and blowers run at full speed.

Blower circuits are protected by number 3 and 4 circuit breakers on circuit breaker panel at left of driver. Wiring circuit diagrams for Heating

and Ventilation System, both with and without air conditioning, are included in back of manual.

Blower Relay

Adjustment instructions for blower relay are described in "WIRING AND MISCELLANEOUS ELECTRICAL" (SEC. 7).

Blower Motors

Blower motors require no periodic maintenance, and should operate indefinitely without attention. In the event of failure, motors can be disassembled, brushes replaced, and commutator turned and undercut in accordance with established practice. Do not turn commutator more than necessary to obtain smooth surface. Whenever motors are disassembled, bearings should be lubricated at reassembly.

SPECIFICATIONS

PASSENGER CHIME

Part Number 2164961
Type Single Tone

WINDSHIELD DEFROSTER MOTORS

Make Redmond Co. Inc.
Type Series Wound
Rotation (Shaft End)
Right-hand Motor Clockwise
Left-hand Motor Counterclockwise
Speed 2400 rpm
Current Input (12 volts) 3.8 amps

OUTSIDE AIR BLOWER MOTORS

Make Delco-Remy
Model 5047591
H.P. 1/15
Volts 13.0
Current 7.2 amps
Speed 2350 rpm

UNDER FLOOR HEATER BLOWER MOTORS

Make Delco Products
Model
Right-hand Motor A-7481
Left-hand Motor A-7482

H.P. 1/4
Volts 12
Rotation (Commutator end)
Right-hand Motor Counterclockwise
Left-hand Motor Clockwise

HEATER BLOWER MAGNETIC SWITCHES

Make Essex Wire Corp.
Type 5608-9
Volts 12

HIGH TEMPERATURE OVERRULE THERMOSTAT

Make Spencer
Mfg's Part No. B6490-30
Type RT 2-30
Terminals Used 1 and 3
Temperature Range 65°-95° F.
Temperature Differential 1-1/4° F.
Dial Locked at 85° F.

GRAD-U-STAT

Make Minneapolis-Honeywell
Type TE 0900AX67

MODULATION VALVE

Make Minneapolis-Honeywell
Type V053A55

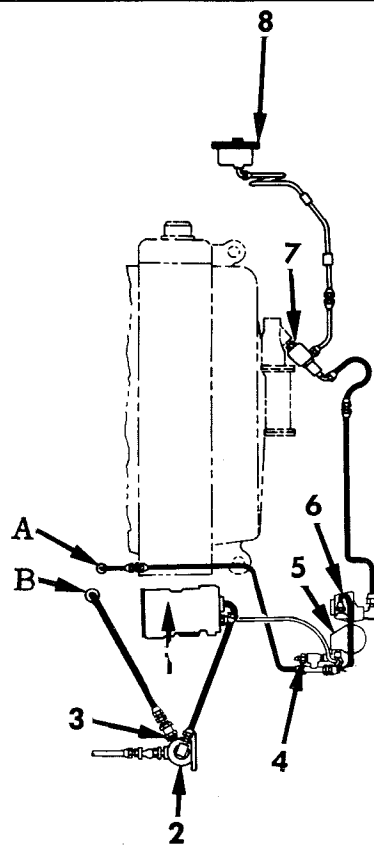
<u>Unit</u>	<u>Location</u>
1 Air Compressor	Rear of Engine
2 Compressor Discharge Muffler	Upper Right-hand Corner of Engine Comp't.
3 Discharge Line Check Valve	At Discharge Muffler Outlet
4 Outside Supply Valve	On Bulkhead Above Engine
5 Air Compressor Governor	On Bulkhead Above Engine
6 Radiator Shutter Air Filter	On Bulkhead Above Engine
7 Radiator Shutter Thermostat	In Engine Thermostat Housing
8 Radiator Shutter Air Cylinder	Top of Radiator Shutters
9 Discharge Muffler Drain Cock	Bottom of Discharge Muffler
10 Rear Brake Chambers	At Each Rear Wheel
11 Rear Brake Relay Valve	On Crossmember Ahead of Rear Axle
12 Stop Light Switch	Top of Relay Valve
13 Air Line to Pressure Regulating Valve and Grad-U-Stat. In Forward Baggage Comp't.	
14 Safety Valve	Top of First Main Air Tank
15 Main Air Tanks	Under Vehicle Behind Front Axle
16 Main Air Tank Drain Cocks	Bottom of Air Tanks
17 Front Brake Chambers	At Each Front Wheel
18 Auxiliary Air Tank	Under Vehicle Ahead of Front Axle
19 Brake Pressure Test Fitting	Top of Quick Release Valve
20 Front Brake Quick Release Valve	On Crossmember Ahead of Front Axle
21 Auxiliary Air Tank Drain Cock	Bottom of Air Tank
22 Low Air Pressure Switch	In Tool Compartment
23 Pressure Regulating Valve	In Tool Compartment
24 Auxiliary Air System Check Valve	In Tool Compartment
25 Air Horns	In Tool Compartment
26 Air Horn Foot Valve	In Toe-board at Left of Driver
27 Brake Application Valve	Under Toeboard
28 Air Pressure Gauge	In Gauge Panel
29 Windshield Wiper Valves	Below Switch Panel
30 Windshield Wipers	Below Windshields
31 Air Strainer	Behind Gauge and Switch Panels

Air Line Diagram - PD-4103 TP-7097

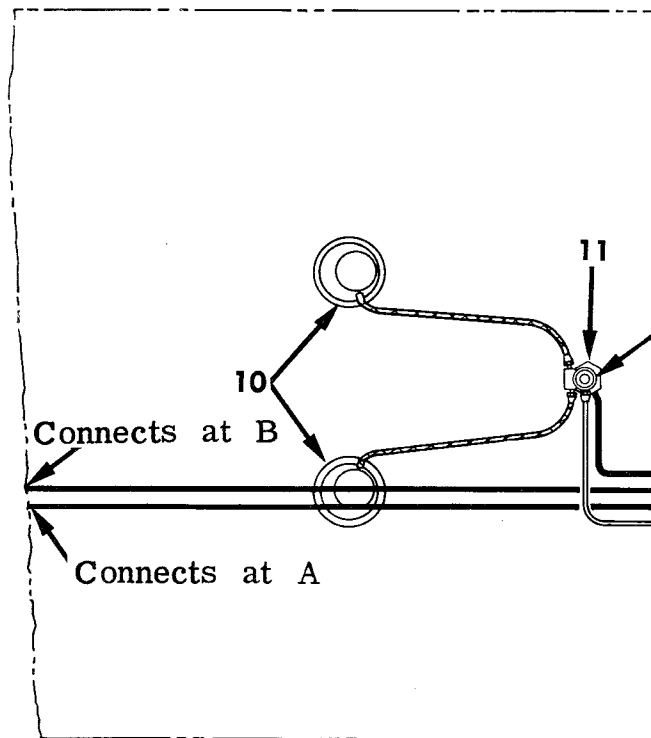
Unit

- 1 Air C
- 2 Compr
- 3 Discha
- 4 Outside
- 5 Air C
- 6 Radiate
- 7 Radiate
- 8 Radiate
- 9 Discha
- 10 Rear L
- 11 Rear L
- 12 Stop L
- 13 Air Li
- 14 Safety
- 15 Main A
- 16 Main A
- 17 Front
- 18 Auxilia
- 19 Brake
- 20 Front
- 21 Auxilia
- 22 Low A
- 23 Pressu
- 24 Auxilia
- 25 Air Ho
- 26 Air Ho
- 27 Brake
- 28 Air Pr
- 29 Windsh
- 30 Windsh
- 31 Air St

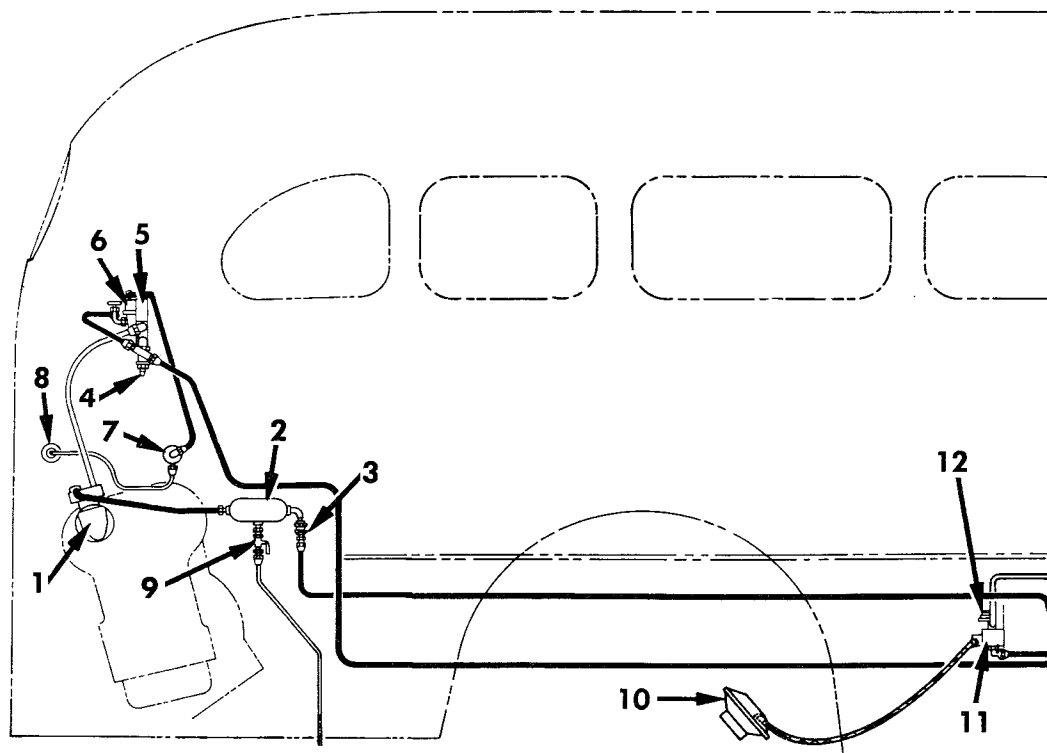
Take

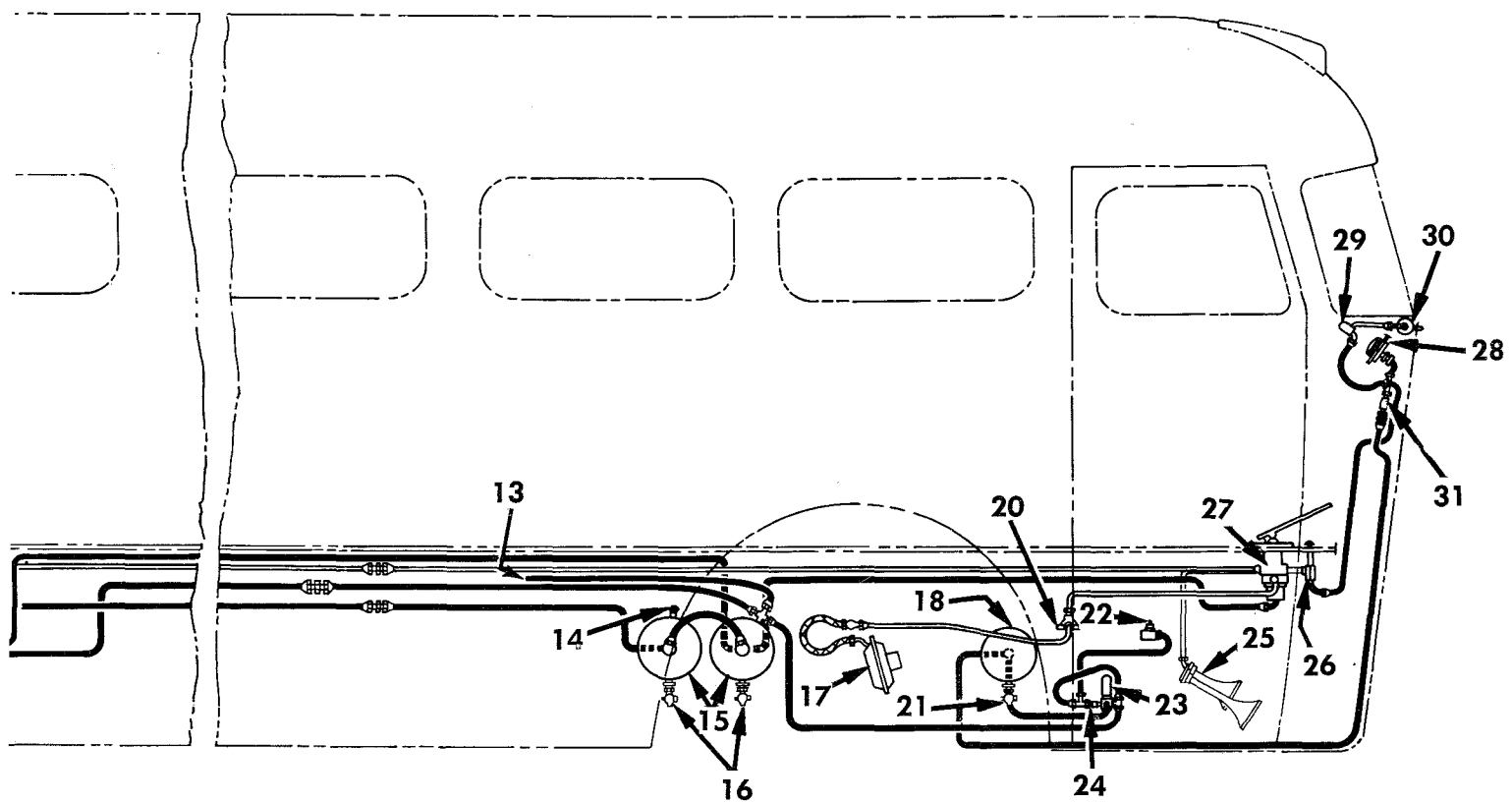
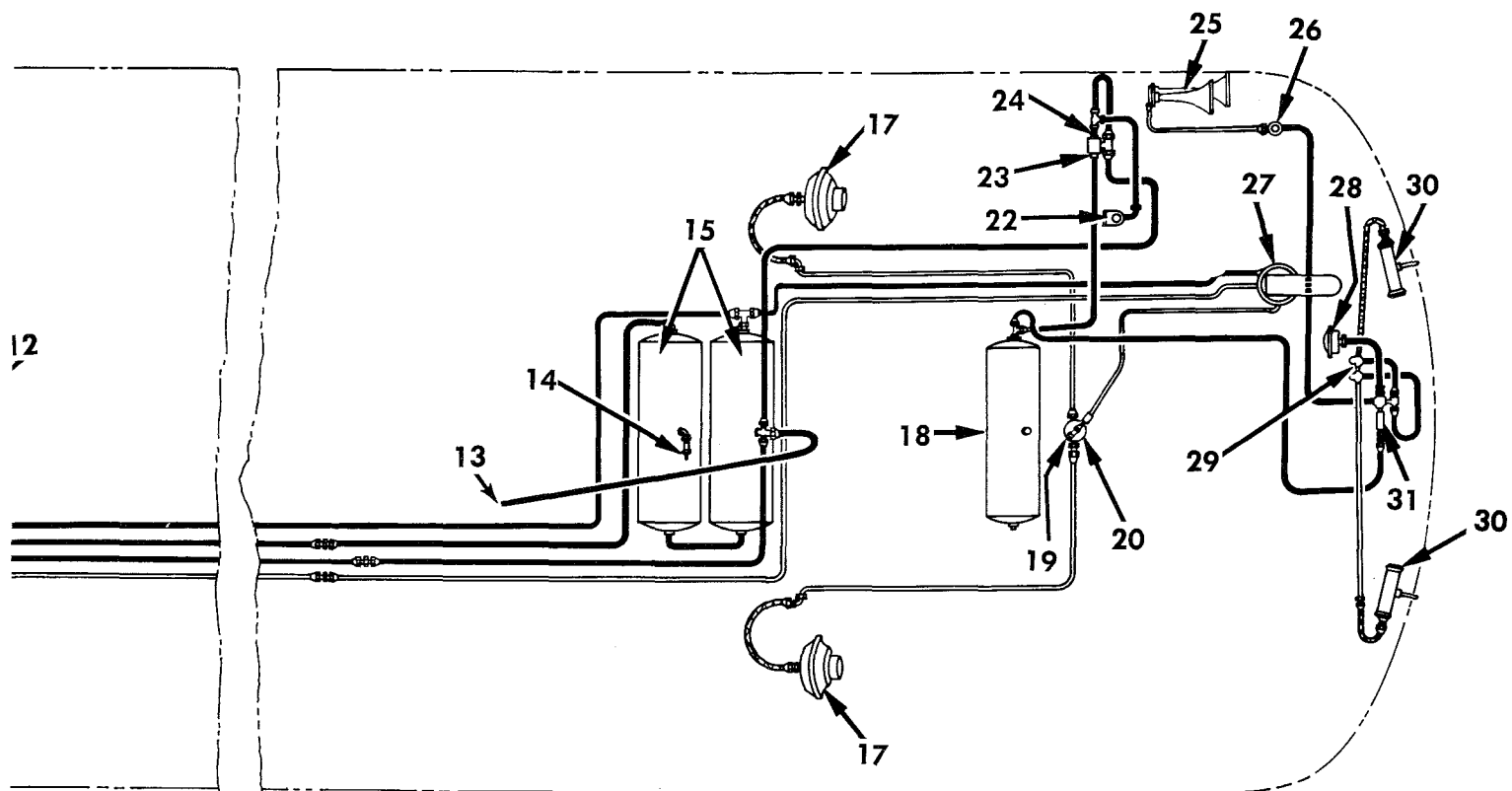


REAR VIEW



PLAN VIEW





Brakes

This group, covering complete maintenance and repair information on Brakes, is divided into four sections as shown in Index below:

Section Name	Page No.
Air Brakes	43
Air Compressor and Governor	63
Hand Brake	75
Brake Specifications	77

Air Brakes

4

Air Line Diagram shows air lines installation and approximate location of air pressure controls and devices. No attempt is made to show details of the various air system units in the air line diagram; each unit is illustrated in detail later in this section, or in other sections of this manual as indicated under "Miscellaneous Air-Operated Equipment" later in this section.

The air system may be classed as two interconnected systems, the Main Air Brake System and the Auxiliary Air System. The main air brake system supplies and controls air pressure for operation of brakes and radiator shutter controls, and supplies air pressure for the auxiliary air system. The auxiliary air system controls air pressure for operation of windshield wipers, air horn, and air pressure gauge.

Solid black lines in Air Line Diagram are "hot" lines; that is, they contain full air system pressure at all times. Open lines contain air pressure only when they are delivering air pressure to their respective units.

OPERATION

MAIN AIR BRAKE SYSTEM

Air pressure, created by air compressor, is discharged through the discharge muffler into the line leading to the first main air tank. Air pressure is directed from this tank into the second main air tank. Two hot lines lead from the left-hand end of the second main air tank, one delivering air pressure to the brake application valve, the other delivering air pressure to the rear brake relay valve. Two hot lines lead from the top of the second main air tank, one delivering air pressure to the rear of the vehicle for operation of the air compressor governor and radiator shutter controls, the other delivering air pressure to the low air pressure indicator and, via the pressure

regulating valve, to the auxiliary air system (auxiliary tank).

The pressure regulating valve permits air pressure to pass into the auxiliary air system when pressure in the main air brake system reaches 65 pounds. The low air pressure switch closes an electrical circuit in the telltale alarm system when the pressure in the main air system is below the valve setting (60 pounds, plus or minus 6 pounds). This causes the buzzer to sound and the low air pressure telltale to light.

When brakes are applied, air pressure passes through the application valve into the lines leading to the front brake quick release valve and to the rear brake relay valve. This air pressure passes through the front brake quick release valve into the front brake chambers, while pressure to the relay valve only operates the valve, permitting air pressure from the air tank to pass through the valve into the rear brake chambers.

When brakes are released, air pressure in the rear brake chambers is exhausted at the relay valve, air pressure in the front brake chambers is exhausted at the quick release valve, and air pressure in the lines from the application valve to the relay and quick release valves is exhausted at the application valve.

AUXILIARY AIR SYSTEM

No air pressure is admitted to the auxiliary air system until pressure in the main air brake system reaches 65 pounds. When pressure reaches 65 pounds, the pressure regulating valve permits air pressure to pass into the auxiliary air tank. The hot line leading from the auxiliary tank delivers air pressure to the windshield wiper valves, air horn valve, and air pressure gauge.

In the event the pressure in the main air brake system is lowered below 65 pounds, pressure in the auxiliary air system returns to the main air brake system through the one-way check valve.

AIR BRAKES

MISCELLANEOUS AIR OPERATED EQUIPMENT

STOP LIGHT SWITCH

Air-operated stop light switch operates stop lights as brakes are applied. Refer to "LIGHTING SYSTEM" in ELECTRICAL (SEC. 7).

AIR HORNS

Information on air horns and horn foot control valve will be found in BODY (SEC. 3).

WINDSHIELD WIPERS

Information on windshield wipers is covered in BODY (SEC. 3).

RADIATOR SHUTTER POWER CYLINDER, AIR STRAINER, AND THERMOSTAT

These units are used in conjunction with the engine cooling system. Refer to "RADIATOR AND SHUTTERS" in COOLING SYSTEM (SEC. 6).

HEATING SYSTEM GRAD-U-STAT, PRESSURE REGULATING VALVE, AND MODULATION VALVE

These units are used in conjunction with the under floor heating system. Refer to BODY (SEC. 3) for description of operation and adjustment and repair procedures.

MAINTENANCE

Procedures for testing, adjusting, and overhauling the various items included in the air brake system are described under individual headings later in this section. It is imperative that all air tanks and air compressor discharge muffler be drained daily to eliminate any condensation which has collected.

In cold weather, particular attention should be given to draining moisture from the air system. When necessary to protect the system against freezing, an alcohol evaporator should be used to introduce alcohol vapor into the air system.

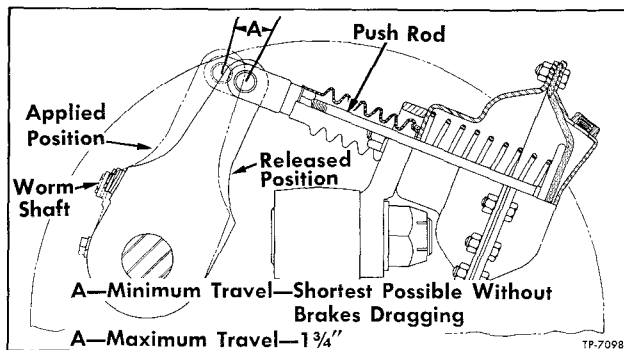


Figure 1—Brake Chamber Push Rod Travel

Detailed specifications are tabulated at end of this group, and a "Trouble Shooting" table is provided in TROUBLE SHOOTING (SEC. 21) to facilitate analysis and correction of improper operation. Refer to "AIR COMPRESSOR AND GOVERNOR" section later in this group for information on air compressor and governor.

BRAKE ADJUSTMENT

BRAKE SHOE ADJUSTMENT

Service brake adjustment for normal lining wear is made by turning slack adjuster worm shaft (fig. 1). Brake chamber push rod travel should be checked after every 1000 miles of operation to determine whether adjustment is necessary. While maximum travel is permissible, it is advisable to maintain travel as close to minimum as possible, both for braking efficiency and for economy in air consumption. Brake linings should be replaced when they become worn to a thickness of 5/16" at center of shoe.

1. Always check wheel bearing adjustment before attempting to adjust brakes. Refer to "HUBS AND BEARINGS" (SEC. 19).

2. Measure push rod travel from fully released to fully applied position. If travel is approaching maximum shown in figure 1, adjustment is required.

3. With wheel jacked up, turn slack adjuster worm shaft until brake drags, then back off until wheel turns freely.

NOTE: Lock sleeve must be pushed in before worm shaft can be turned. Make sure sleeve is pushed in far enough to clear hex end of worm shaft before turning shaft.

4. Be sure wheel turns freely with no brake drag when brakes are fully released. After completing adjustment, make sure lock sleeve comes out and engages head of worm shaft. Pry sleeve out with screwdriver if necessary. Coat lock sleeve and end of worm shaft with wheel bearing grease to keep out dirt and water to assure free movement of sleeve at next adjustment.

BRAKE TREADLE ADJUSTMENT (Fig. 7)

1. With treadle in released position, adjust screw under heel of treadle until treadle roller just touches the valve cap.

2. Loosen lock nut on treadle stop screw and turn screw down several turns.

3. Push treadle down as far as it will go, then set stop screw to this position.

4. Raise treadle two full turns of stop screw, then hold stop screw in this position and tighten lock nut.

AIR BRAKES

AIR COMPRESSOR DISCHARGE MUFFLER

Air compressor discharge muffler is connected into compressor discharge line as shown on Air Line Diagram at beginning of this group. Purpose of muffler is to arrest the pulsation noises (ping) caused by discharge of compressed air from the reciprocating air compressor.

Since the discharge muffler is the first unit the hot compressed air enters, considerable condensation collects in the unit. This condensation must be drained daily. Drain cock and drain tube are provided at bottom of muffler.

Muffler should be removed at regular intervals and the inside cleaned of carbon deposits or other foreign material.

AIR TANKS

Air tanks are connected in air system as shown in Air Line Diagram at beginning of this group. Air tanks are mounted at lowest points in system to permit drainage of condensation into tanks.

The purpose of the air tanks is to provide a place to store compressed air so there will always be an ample supply available for immediate use for brake operation. They also provide storage for sufficient compressed air to permit several brake applications after the engine stops.

Another purpose of the tanks is to provide a place where the air, heated during compression, may cool and the oil and water vapors condense. This condensation must be drained daily.

Check all tank mounting bolts for looseness at regular intervals and tighten if necessary. Air tanks may be cleaned inside using steam or hot water. Inspect tank inside and out for corrosion. The interior may be inspected with the aid of a small flashlight. If corrosion or other damage has weakened the tank, it must be replaced.

SAFETY VALVE

A safety valve, shown in figure 2, is installed in one of the air tanks to eliminate the possibility of air pressure building up in the system beyond a predetermined maximum.

OPERATION

When reservoir pressure is built up to exceed 150 pounds, force of air pressure forces ball (4) off seat (B), permitting air pressure in excess of 150 pounds to escape through exhaust port (A) to atmosphere. After pressure bleeds down, spring (3) forces ball (4) back on seat (B).

MAINTENANCE

Check safety valve periodically for leakage, using soap suds at exhaust port. Leakage should not exceed a 1-inch bubble in 5 seconds. Once a year, valve should be dismantled, cleaned with kerosene, and reset to blow off at 150 pounds.

ADJUSTMENT (Fig. 2)

Set safety valve in following manner:

1. Loosen lock nut (2).
2. Adjust set pressure by turning adjusting nut (1). Turn nut clockwise to increase pressure, or counterclockwise to decrease pressure.
3. Tighten lock nut (2).

AIR LINES

Metal tubing and flexible hose are used to connect the various units of the air brake system. Service instructions for both types follow:

METAL TUBING

Metal air lines are of annealed copper tubing with three-piece compression type fittings. Flared type fittings should never be used in air brake systems. Connections should be tested for leakage at least every 5000 miles and tightened or replaced if necessary. When replacing metal tubing, tubing must be free of burrs, copper cuttings, and dirt. Blow out with compressed air. Any of the above mentioned particles will destroy sealing seats in air control units. New tubing must be of the same size as the old tubing.

FLEXIBLE HOSE

Flexible hose is used at each brake chamber where it is impossible to use metal tubing due to constant flexing during vehicle operation. Hose connections should be tested for leakage at least every 5000 miles and tightened or replaced if necessary. Any hose which is chafed, worn, or kinked should be replaced.

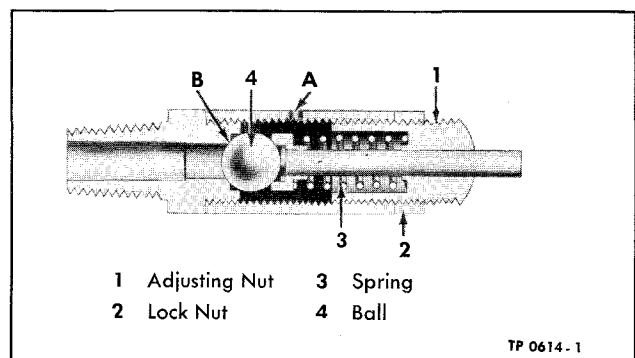


Figure 2—Safety Valve

AIR BRAKES

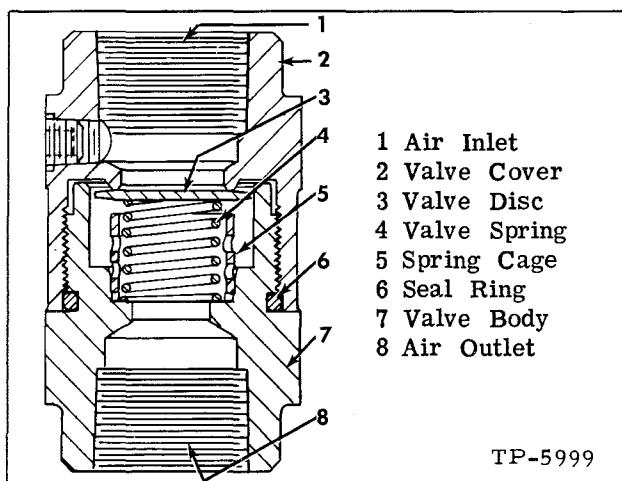


Figure 3—Discharge Line Check Valve

SERVICEABILITY TESTS

1. Operating Test

If any of the symptoms given under "Air Brakes" in TROUBLE SHOOTING (SEC. 21) indicate that a metal tube or flexible hose is restricted, disconnect tube or hose at both ends and blow through it to make sure the passage is clear. Inspect tubing or hose for partial restriction such as would be caused by dents or kinks. If such a condition is found, tubing or hose should be replaced.

2. Leakage Test

With air system fully charged and brakes applied, coat all tubing and hose connections with soap suds to check for leakage. No leakage is permissible. Leakage can sometimes be corrected by tightening the connection. If this fails to correct leakage, new fittings, metal tubing, or flexible hose must be installed.

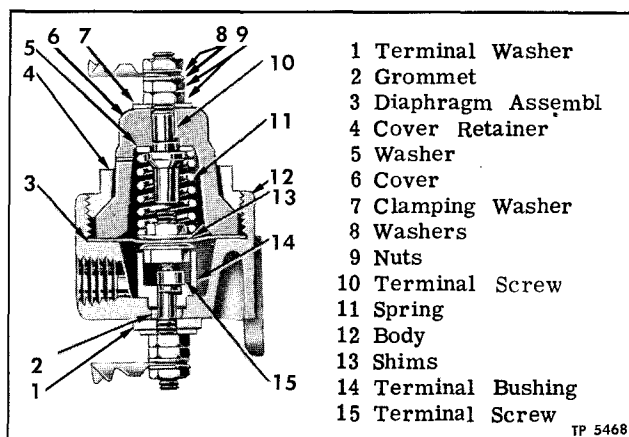


Figure 4—Low Air Pressure Switch

AIR PRESSURE GAUGE

The air pressure gauge in the instrument panel is connected into the air lines as shown in Air Line Diagram at beginning of this group. Since the gauge receives its air pressure from the auxiliary air tank, it will register no increase in pressure until the pressure in the main air brake system is built up above 65 pounds; however, the gauge will register a decrease in pressure, regardless of pressure in system, since pressure in auxiliary air system returns to main air brake system as the pressure in the latter system is reduced.

The vehicle should never be put in motion until the air pressure registers at least 65 pounds. If pressure drops below 60 pounds (low pressure buzzer sounds), stop vehicle immediately and determine cause of pressure loss. Check gauge regularly with an accurate test gauge. Replace with a new or recalibrated unit if reading varies four pounds.

DISCHARGE LINE CHECK VALVE

One-way check valve (fig. 3) is installed in air compressor discharge line as shown in Air Line Diagram at beginning of this group. This valve performs no function in the air system except as a safety device. In the event of leakage or breakage in the air compressor to muffler line, check valve prevents loss of air pressure from the air system. Check valve should be removed, disassembled, and cleaned at regular intervals. Valve disc should be turned over if worn on one side, and a new seal ring should be used when assembling. When installing valve, make sure it is installed to permit air flow in direction of arrow on valve body.

LOW AIR PRESSURE SWITCH

The low air pressure switch (fig. 4) is a safety device designed to automatically give a warning when pressure in air system falls below a safe limit for brake operation. The low air pressure switch is actually an air controlled switch in an electrical circuit, automatically controlling a telltale light and buzzer. Operation of telltale alarm system is explained in "WIRING AND MISCELLANEOUS ELECTRICAL" in ELECTRICAL (SEC. 7). Low air pressure switch is connected in air lines as shown in Air Line Diagram at beginning of this group. Refer to "Alarm and Signal Wiring Diagram" in back of manual for electrical circuits.

OPERATION (Fig. 4)

When the system air pressure under the diaphragm is about 60 pounds, the force exerted by

AIR BRAKES

the air pressure overcomes the force exerted by the diaphragm spring above the diaphragm, and the electrical contacts remain open.

When the air pressure drops below 60 pounds, the diaphragm spring exerts a force above the diaphragm which is greater than the force exerted by the air pressure below the diaphragm. This will cause the diaphragm to move down and close the electrical contacts. This completes electrical circuit to buzzer and telltale light, informing driver of his impending loss of air pressure.

The nominal pressure setting of 60 pounds is subject to a tolerance of plus or minus 6 pounds so that the actual operating pressure of the low air pressure switch may vary between 66 pounds maximum and 54 pounds minimum.

SERVICEABILITY TESTS

1. Operating Test

Operation of the low air pressure switch may be checked by reducing the system pressure and being sure that the contacts close when the reservoir pressure is between 66 pounds maximum and 54 pounds minimum. The contacts will be closed when the telltale light and electrical buzzer operate.

2. Leakage Test

A small vent hole is provided in the cover of the low air pressure switch to check the condition of the diaphragm. Cover the vent hole with soap suds. If a leak is indicated it signifies a ruptured diaphragm. The diaphragm should then be replaced.

DISASSEMBLY (Fig. 4)

1. Unscrew cover retainer (4) from body (12).
2. Remove cover (6) and lift out spring (11) and diaphragm assembly (3).

CLEANING AND INSPECTION

Clean all metal parts in cleaning solvent. Examine diaphragm for signs of cracking, wear, or damage. Replace diaphragm if these conditions are found.

Inspect contact points for signs of pitting or wear. If pitting is not too severe, contacts may be reconditioned by filing with a fine distributor point file. If they cannot be reconditioned, they should be replaced.

Check spring for tension. If it has lost its tension, it should be replaced.

ASSEMBLY (Fig. 4)

1. Position diaphragm assembly (3) in body (12).
2. Place spring (11) so it will be on the upper diaphragm follower.

3. Place cover (6) over diaphragm (3). Install cover retainer (4) and cover (6) and thread into body (12). Tighten retainer firmly.

4. Test switch as previously directed under "Serviceability Tests." If pressure setting requires adjustment, add or remove shims (13) under spring.

PRESSURE REGULATING VALVE

Pressure regulating valve (fig. 5) is connected in air lines as shown in Air Line Diagram at beginning of this group. The unit consists essentially of a valve diaphragm and spring, enclosed by a valve body and cover. Adjustment is made by means of the adjusting screw in the cover.

The pressure regulating valve serves two purposes in the air system. One purpose is to prevent air pressure from entering the auxiliary air system until pressure in the main air brake system reaches 65 pounds. This provides a rapid build-up of pressure in the main air brake system for operation of brakes. When air pressure in main air brake system reaches 65 pounds, the pressure regulating valve admits pressure into the auxiliary air system for operation of windshield wipers, air horn, and air pressure gauge. The second purpose of the pressure regulating valve is to prevent lowering pressure below 65 pounds in main air brake system by operating windshield wipers or air horn, or by leakage in the auxiliary air system air lines.

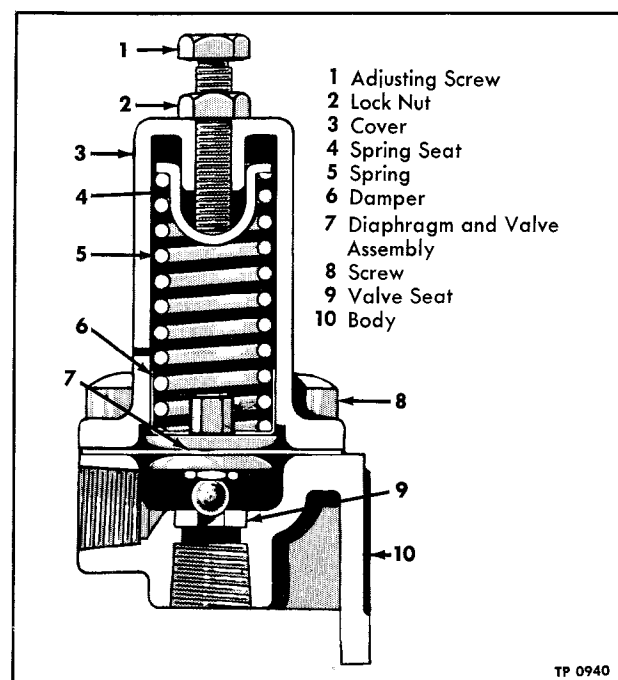


Figure 5—Pressure Regulating Valve

AIR BRAKES

SERVICEABILITY TESTS

1. Operating Test

Exhaust air pressure from system and install a test gauge in air brake system, preferably in the air line leading from air tank to the pressure regulating valve. Disconnect one of the windshield wiper air lines at the wiper motor. Build up pressure in system and note pressure when the valve permits air to pass to atmosphere. If pressure varies 5 pounds from the original setting (65 lbs.), the valve requires adjustment.

2. Leakage Test

With air line disconnected at bottom of valve and pressure in air brake system below the valve setting (65 lbs.), coat the bottom opening of valve with soap suds. Leakage is caused by dirt on the valve seat or by an excessively worn valve.

ADJUSTING SET PRESSURE (Fig. 5)

The pressure at which the valve is unseated is controlled by the adjusting screw (1). Setting may be increased or decreased by turning screw.

1. Back off lock nut (2), then turn screw (1) clockwise to increase pressure, or counterclockwise to decrease pressure.

2. Tighten lock nut (2) when correct adjustment is obtained.

REPLACEMENT

1. Removal

Exhaust air from system and disconnect air lines. Remove mounting bolts and remove unit from vehicle.

2. Installation

Position unit and install mounting bolts. Connect air lines and test valve as previously directed under "Serviceability Tests."

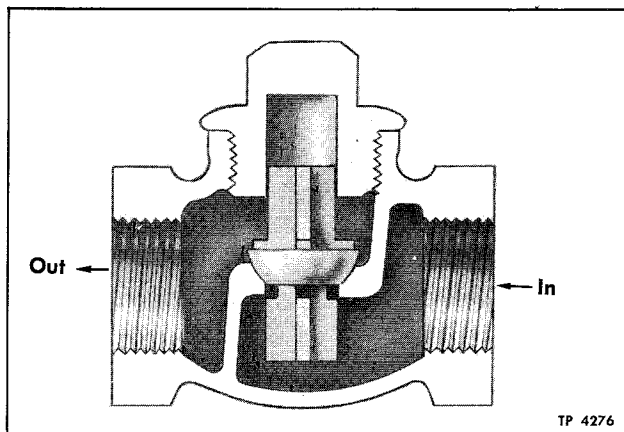


Figure 6—Auxiliary Air System Check Valve

DISASSEMBLY (Fig. 5)

Remove four screws (8) attaching cover (3) to body (10) and remove cover. Remove spring (5), spring seat (4), and damper (6) from cover and lift diaphragm and valve assembly (7) off body.

INSPECTION (Fig. 5)

Clean all parts thoroughly, using a suitable cleaning fluid. Examine diaphragm for cracks or wear. If either the valve or diaphragm are worn or damaged, a new diaphragm and valve assembly should be installed. Inspect valve seat in body and valve seat assembly.

ASSEMBLY (Fig. 5)

Place diaphragm and valve assembly (7) on body, with valve seated in valve seat in body. Install spring seat (4), spring (5), and damper (6) in cover (3) and position cover on body (10). Install four screws (8) through cover and diaphragm into body and tighten firmly. Adjust set pressure as previously directed under "Adjusting Set Pressure."

AUXILIARY AIR SYSTEM CHECK VALVE

Auxiliary air system check valve (fig. 6), consisting of a valve body, valve, and valve cap, is connected into air lines at pressure regulating valve as shown in Air Line Diagram at beginning of this group. This valve is a one-way valve, permitting air pressure to flow through it in one direction only. Check valve prevents air pressure flowing into the auxiliary air system without passing through the pressure regulating valve; however, it permits air pressure in the auxiliary air system to return to the main air brake system when the pressure in the main air brake system is reduced. Whenever check valve is removed, it is essential that it be reinstalled to permit air flow in direction indicated by arrow on Air Line Diagram.

BRAKE APPLICATION VALVE

Brake application valve (fig. 7) is a treadle type D-1 brake valve mounted underneath the toeboard on the left side of the vehicle. Brake treadle and roller assembly is mounted on top of the toeboard. Application valve is connected into air lines as shown in Air Line Diagram at beginning of this group.

APPLICATION VALVE OPERATION (Fig. 7)

1. Application

As the driver depresses the brake treadle, pressure is transmitted through the treadle roller, valve cap, and spring cage to the pressure regu-

AIR BRAKES

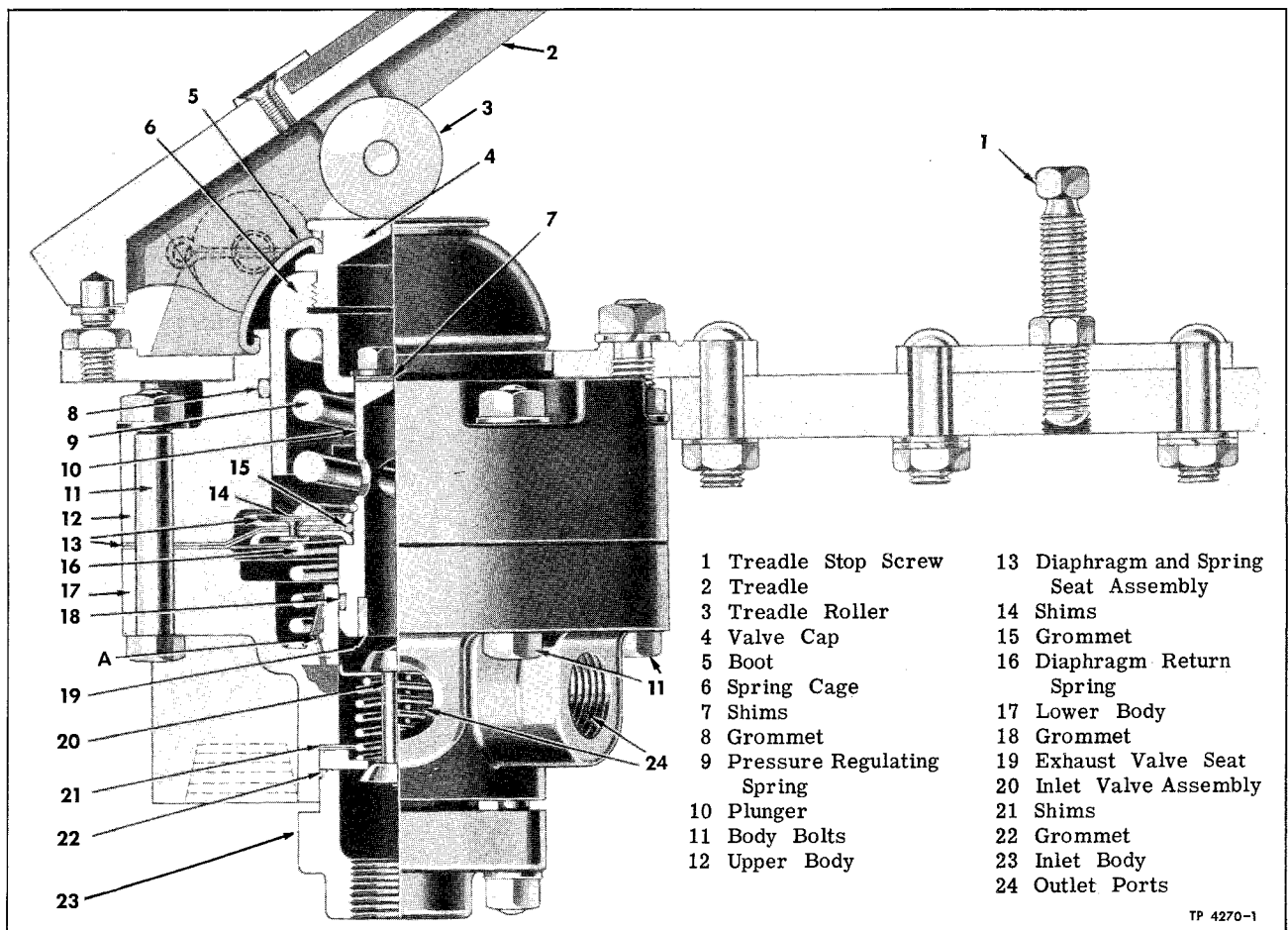


Figure 7—Brake Application Valve

lating spring and diaphragm. As the diaphragm and plunger moves downward, the exhaust valve seat contacts the exhaust valve. Continued downward movement of diaphragm and plunger pushes the inlet valve off its seat. This permits air pressure to flow through the inlet valve and into the lines leading to the front and rear brakes.

2. Holding

The compensating port (passage A) in the lower body casting permits the same air pressure being delivered to the brakes to enter the cavity below the diaphragm. When air pressure in cavity below diaphragm balances the mechanical force on top of the diaphragm, the diaphragm moves upward, permitting the inlet valve to close but not enough to open the exhaust valve. This prevents additional pressure from being delivered to the brakes, and at the same time prevents pressure already delivered from escaping through the exhaust valve and exhaust port, and brakes are held in applied position. Should the driver depress the brake treadle still further, exerting additional

force on top of the diaphragm, a corresponding increase in air pressure being delivered to the brakes results.

If the driver depresses the treadle to fully applied position, the pressure regulating spring is compressed and the spring cage strikes the spring seat. Under these conditions, the inlet valve is held open permitting full air system pressure to pass through the valve to the brakes.

3. Partial Release

If the driver permits the treadle to partially return toward its released position, reducing the mechanical force on top of the diaphragm, the air pressure below the diaphragm overcomes the mechanical force on top of it. When this occurs, the diaphragm lifts, closing the inlet valve and opening the exhaust valve, permitting air pressure in cavity below diaphragm to escape through the exhaust port until the pressure below the diaphragm again balances the mechanical force on top of it.

4. Release

When the driver permits the brake treadle to

AIR BRAKES

return to its fully released position, the exhaust valve remains open and all pressure in the cavity below the diaphragm and in the air lines connected to this cavity is exhausted and the brakes return to released position.

APPLICATION VALVE SERVICEABILITY TESTS

1. Operating Tests

a. Check the delivery pressure of the valve, using an accurate test gauge. The gauge should be connected to the test opening provided in the tee fitting on top of the front brake quick release valve. With the treadle fully depressed against the treadle stop on the toeboard, test gauge should show approximately full air system pressure as registered by the dash gauge.

b. Depress and hold the brake treadle in several positions between fully released and fully applied position and make sure the delivered pressure registered by the test gauge varies in accordance with the position in which the brake treadle is held. The valve must control all delivery pressures between 5 and 70 pounds; above 70 pounds, full air system pressure should be delivered. If full system pressure is not delivered, check treadle stop screw adjustment as previously directed under "Brake Adjustments" in this section. If valve does not graduate the delivered pressure properly (between 5 and 70 pounds), it is an indication that passage A (fig. 7) is restricted.

c. With brake treadle fully released, test gauge must register zero. If gauge does not promptly return to zero, check for clearance between treadle roller and valve cap. Refer to "Brake Adjustments" previously in this section.

2. Leakage Tests

a. With treadle fully released, coat the brake valve exhaust port with soap suds to check for leakage. Leakage in excess of a one-inch soap bubble in one second is not permissible. Leakage evidenced by this test may be caused by inlet valve not seating properly.

b. With treadle fully depressed, coat the exhaust port with soap suds. Leakage in excess of a one-inch bubble in one second is not permissible. Leakage evidenced by this test may be due to a leaking exhaust valve or a leaking diaphragm.

APPLICATION VALVE REPLACEMENT

1. Removal

Exhaust air from system and disconnect air lines. Remove mounting stud nuts at top side of toeboard and remove unit from under vehicle.

2. Installation

Position unit in vehicle and install mounting stud nuts. Connect air lines, then start engine

and build up air pressure. Adjust treadle as previously directed under "Brake Adjustments." Test valve as previously directed under "Serviceability Tests."

APPLICATION VALVE DISASSEMBLY (Fig. 7)

1. Clean all dirt from exterior of unit prior to disassembly. Mark lower body in some manner that will identify location of the three long body bolts so outlet openings will be in correct position when valve is reassembled.

2. Pull rubber boot off from upper body and valve cap. Remove six bolts holding the upper and lower bodies together and separate bodies.

3. Push on valve cap to remove diaphragm assembly, pressure regulating spring, spring cage, plunger, and valve cap as an assembly from upper body and plunger.

4. Remove nuts and lock washers from three studs securing inlet body to bottom of lower body. Remove inlet body, grommet, inlet valve assembly, and shims from lower body. Tie shims together for use at reassembly.

5. Do not disassemble the diaphragm, plunger, and spring cage assembly unless diaphragm or exhaust valve seat require replacement as indicated below under "Inspection."

INSPECTION (Fig. 7)

Thoroughly clean all parts in a suitable cleaning solvent, then inspect parts as outlined below:

Diaphragm, Spring Cage, and Plunger Assembly

1. Carefully inspect both diaphragms to make sure they are not cracked or deteriorated. If cracks or deterioration are evident, the diaphragm and spring seat assembly must be replaced as directed later under "Repair."

2. Inspect exhaust valve seat in lower end of plunger. If seat is tapered or rough, install new seat as directed later under "Repair."

3. Examine pressure regulating spring for damage. If damaged, the complete diaphragm and spring assembly must be replaced.

Upper Body

Check fit of spring cage in upper body. Spring cage must be a neat sliding fit in body. Examine diaphragm follower seat on bottom of upper body to make sure it is not damaged in such a way as to prevent perfect contact with the diaphragm follower. Inspect seat to make sure it is not nicked or damaged in any way to prevent perfect contact with the diaphragm. Check diaphragm seat radius for burrs or nicks. If any of the above conditions are evident, replace upper body.

Lower Body

Check fit of plunger in lower body. Plunger should be a neat sliding fit in body. Inspect dia-

AIR BRAKES

phragm seat on top of body. If damaged in any way, replace body. Inspect diaphragm follower seat for excessive wear or damage. Replace body if worn excessively or damaged. Inspect small bleed hole leading from outlet port to diaphragm cavity to make sure it is not restricted.

Inlet and Exhaust Valve Assembly

Inspect inlet and exhaust valve assembly for broken spring and worn or damaged valves and seat. If damaged or worn excessively, replace.

REPAIR (Fig. 7)

The following procedure covers disassembly and assembly of the diaphragm, plunger, and spring cage assembly for replacement of the diaphragm or exhaust valve seat.

Disassembly

1. Remove valve cap from spring cage, holding spring cage with a strap wrench or by using a special tool in steps at bottom of cage. Be sure not to score or damage the spring cage.

2. Remove nut from top of plunger, holding the plunger with a rod inserted through the exhaust holes in the plunger. Remove flat washer and shims from top of plunger. Lift spring cage, pressure regulating spring, and shims off plunger and diaphragm assembly. Be sure and keep shims intact for reuse at assembly.

3. Remove snap ring from plunger above diaphragm and lift off diaphragm assembly.

Exhaust Valve Seat Replacement

Pull exhaust valve seat from lower end of plunger. Press new seat into plunger and ream to .515" plus or minus .002". Edge of seat must be sharp and true to form a perfect air seal.

Assembly

1. Place new grommet in diaphragm assembly, then place diaphragm assembly over small end of plunger. Install snap ring on plunger to hold diaphragm in place.

2. Place pressure regulating spring shims on diaphragm plate, being sure the same shims that were removed are used.

3. Place pressure regulating spring and spring cage on diaphragm and plunger. Compress pressure regulating spring and install shims, washer, and nut on top of plunger. Make sure the same shims that were removed are used. Tighten nut firmly and stake in place.

4. Thread valve cap into top of spring cage, tighten firmly and stake in place.

APPLICATION VALVE ASSEMBLY (Fig. 7)

1. Place lower valve body on bench, bottom side up. Drop inlet valve shims into valve opening

in bottom of body, being sure the same shims that were removed are used. Place inlet valve assembly in body, with the valve guide inserted in the bore in body.

2. Place new inlet valve body grommet in body on top of inlet valve seat, then install inlet valve body. Install lock washers and nuts on inlet valve body studs and tighten firmly.

3. Turn lower body over and place diaphragm return spring in body.

4. Install new grommets in grooves in plunger and upper body. Coat surface of spring cage and plunger lightly with petroleum jelly, then insert spring cage into upper body and align opening in diaphragm with opening in body.

5. Place upper body and diaphragm assembly on lower body with the lower end of the plunger inserted in bore in lower body and with the exhaust opening in diaphragm aligned with exhaust opening in lower body.

6. Align bolt holes in upper body, diaphragm, and lower body, and install six body bolts. Make sure the three long bolts are installed in the correct holes as marked on lower body prior to disassembly. Install lock washers and nuts on bolts and tighten firmly.

7. Install rubber boot on top of valve assembly, making sure edges of boot are properly seated in grooves in valve cap and upper body. Press down on valve cap several times to make sure the spring cage slides freely in upper body.

TEST AND ADJUSTMENT OF
REBUILT APPLICATION VALVE (Fig. 7)Tests

Install rebuilt application valve in vehicle and test as previously directed under "Serviceability Tests" in this section. If valve does not meet requirements given in "Operating Test," make adjustments described below. If valve does not pass the "Leakage Test," valve must be removed and leakage corrected.

Adjustments

1. If the valve does not release promptly, or does not fully release, it indicates that the exhaust valve is not opening sufficiently. This can be caused by:

a. Improper adjustment of treadle adjusting screw, causing roller to exert too much force on valve cap when treadle is released.

b. Insufficient shims between inlet valve seat and body of brake valve.

2. If the brake valve does not apply promptly, or does not fully apply, it indicates that the inlet valve is not opening sufficiently. This can be caused by:

AIR BRAKES

a. Improper adjustment of treadle stop screw, preventing full travel of treadle.

b. Too many shims between inlet valve seat and body of brake valve.

3. Adjustment of brake valve to obtain correct inlet and exhaust valve opening is as follows:

a. With the treadle adjusting screw turned down as far as it will go, apply and release brakes several times to insure free movement of spring cage in upper body.

b. Turn adjusting screw up until the treadle roller just barely contacts the top of the valve cap. (Make sure the spring cage is up as far as it will go.) Tighten adjusting screw lock nut.

c. Place a 0.155" thickness gauge between roller and valve cap. This should depress the spring cage sufficiently to deliver 5 to 10 pounds pressure. If pressure is too high, add shims between inlet valve seat and valve body. If pressure is too low, remove shims. Adding shims increases the exhaust valve opening when brake is released, and decreases inlet valve opening when brakes are being applied. Removing shims decreases exhaust valve opening when brake is released, and increases inlet valve opening when brakes are being applied.

4. An alternate method of checking the brake valve for correct inlet and exhaust valve opening is as follows:

a. Make sure treadle is fully released and inlet valve is seated. Turn treadle stop screw down so treadle can be depressed to its limit.

b. Place a depth gauge against the inlet valve by inserting the gauge through the air tank supply port in the inlet valve body.

c. Depress the treadle and measure the maximum inlet valve travel. The travel should be 0.148" minimum to 0.156" maximum. Add shims between the inlet valve seat and valve body to decrease the travel. Remove shims to increase the travel.

d. Push treadle down as far as it will go, turn treadle stop screw up against treadle, then raise treadle two full turns of screw to insure

adequate protection of brake valve mechanism. Check the adjustment by accomplishing steps b and c under 3 above.

5. If the brake valve does not graduate the delivered pressure properly, check to be sure bleed hole to the cavity directly below the diaphragm is not restricted.

QUICK RELEASE VALVE

Quick release valve (fig. 8) is installed between front brake chambers as shown on Air Line Diagram at beginning of this group. The purpose of the quick release valve is to reduce the time required to release the brakes by hastening the exhaust of air pressure from the brake chambers. The valve consists of a body containing a spring-loaded diaphragm so arranged as to permit air pressure to flow through the valve in one direction. When the application pressure is reduced, the air pressure which has passed through the valve is permitted to escape through the exhaust port.

OPERATION (Fig. 8)

The quick release valve assumes three positions during normal operation. These three positions are the applying position, when air pressure is passing through the valve into the brake chambers; the holding position, when pressure is being held in the brake chambers; and the releasing position, when pressure is being exhausted from the brake chambers.

1. Applying

When air pressure from the brake application valve enters the top connection of the quick release valve, the diaphragm is forced downward, closing the exhaust port. Air pressure then deflects the outer edges of the diaphragm downward and flows out the side connections of the valve to the brake chambers, applying the brakes.

2. Holding

As soon as the brake chamber pressure below the diaphragm equals the pressure from the application valve above the diaphragm, the force of the spring below the diaphragm forces the outer edge of the diaphragm up against the valve body, although the center of the diaphragm keeps the exhaust port closed.

3. Releasing

When the application pressure on top of the diaphragm is reduced, the brake chamber pressure below the center of the diaphragm raises the diaphragm. This opens the exhaust port and permits air pressure from the brake chambers to exhaust through the exhaust port. If the application pressure on top of the diaphragm is only partially re-

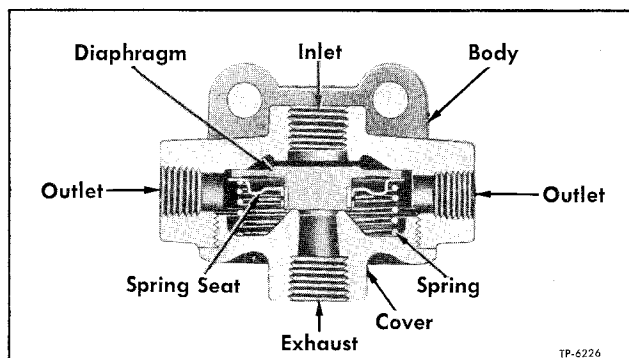


Figure 8—Quick Release Valve

AIR BRAKES

leased, the diaphragm assumes its holding position as soon as the pressures above and below it are equalized. In this manner, the quick release valve acts to pass any increased application pressure through it to the brake chambers, or quickly releases the brake chamber pressure when the application pressure is reduced. It thus maintains the same pressure in the brake chambers as delivered by the application valve.

SERVICEABILITY TESTS

1. Operating Test

Apply brakes and observe that when the brakes are released, air pressure is exhausted through the exhaust port of the valve. Be sure the exhaust port is not restricted in any way.

2. Leakage Test

With brakes applied, coat the exhaust port with soap suds to detect leakage. Leakage in excess of a 1-inch bubble in one second is not permissible. Leakage is caused either by dirt on exhaust seat, by a worn diaphragm, or by a damaged exhaust seat on the valve cover.

In case leakage is caused by dirt on the exhaust seat, the valve should be disassembled and cleaned. If the seat on the diaphragm is worn, diaphragm should be replaced. If the seat on the cover is damaged, the cover should be replaced or the seat lapped as directed later under "Inspection and Repair."

QUICK RELEASE VALVE REPLACEMENT

1. Removal

Exhaust air pressure from system and disconnect air lines from valve. Remove mounting bolts, then remove valve assembly.

2. Installation

Mount valve on frame and tighten mounting bolts firmly. Connect air lines to valve. Build up air pressure in system and test valve as previously directed under "Serviceability Tests."

QUICK RELEASE VALVE DISASSEMBLY (Fig. 8)

Unscrew cover, then lift out diaphragm spring, diaphragm spring seat, and diaphragm.

INSPECTION AND REPAIR

Clean all parts thoroughly. Examine diaphragm for signs of cracking, wear, or damage. Examine lower face of diaphragm which contacts diaphragm seat on cover for signs of pitting or excessive grooving. Replace diaphragm if these conditions are found. Check condition of diaphragm seat on cover. Seat must be smooth and flat. If seat is scratched or pitted, it can sometimes be repaired by carefully lapping the seat, using fine aluminum oxide abrasive cloth on a flat surface.

QUICK RELEASE VALVE ASSEMBLY (Fig. 8)

Place diaphragm and spring seat in valve body. Install spring and cover. Tighten cover firmly.

RELAY VALVE

Relay valve (fig. 9) is installed between the rear brake chambers as shown on Air Line Diagram at beginning of this group. Stop light switch is installed on tee fitting at relay valve inlet. Rear brake application and release is made through the relay valve. The relay valve supply line is connected directly to an air tank, providing a source of high pressure air close to the rear brake chambers at all times. The relay valve and brake application valve are interconnected by a smaller air line, which delivers pressure to actuate the relay valve. In addition to providing more rapid application of the rear brakes, the relay valve also fulfills the function of a quick release valve, permitting rapid release of air pressure from the rear brake chambers.

RELAY VALVE OPERATION (Fig. 9)

The operation of the relay valve is controlled by air pressure delivered to it by the brake application valve. Air pressure from the brake ap-

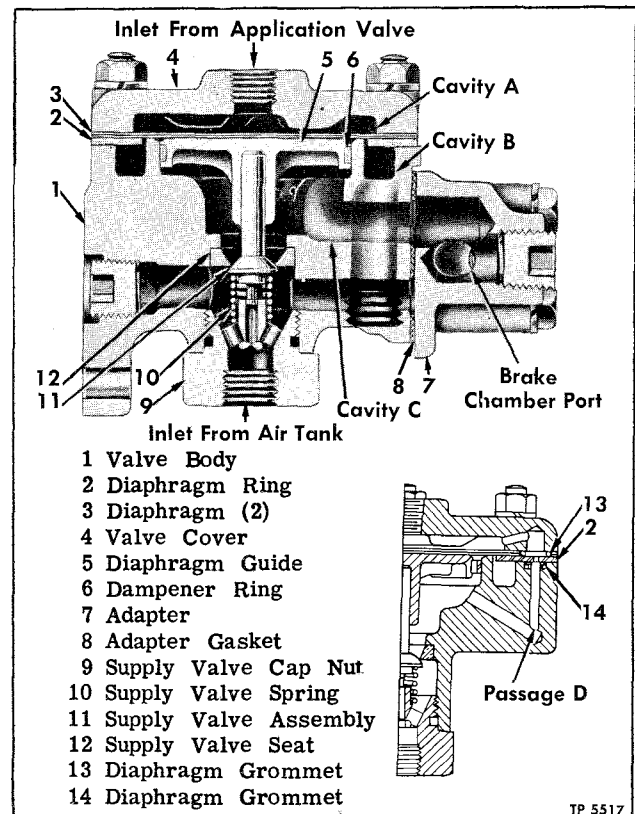


Figure 9—Relay Valve

AIR BRAKES

plication valve enters the cavity above the rubberized diaphragm. Since this cavity is comparatively small and therefore subject to quick changes in air pressure, the action of the valve in changing its delivered pressures is very rapid.

1. Applying

As air pressure from the application valve enters cavity A above the diaphragm, the pressure developed depresses the diaphragm. The diaphragm seals the exhaust port (cavity B) beneath its outer edge and its center is deflected, forcing the diaphragm guide down against the supply valve. Further movement of the diaphragm forces the supply valve off its seat and air pressure from the rear air tank flows through the valve into cavity C below the diaphragm and out the ports to the brake chambers.

2. Holding

As soon as air pressure in cavity A above the diaphragm stops increasing, the pressure below the diaphragm balances the pressure above it by means of the by-pass port (passage D). This balance of pressures permits the center of the diaphragm to rise, removing pressure from the top of the supply valve. This permits the supply valve spring to close the supply valve, and the air pressure above the diaphragm keeps the outer edge of the diaphragm sealing the exhaust port (cavity B). Thus the valve is in its holding position, maintaining the same pressure in the brake chambers as the application valve is delivering to it. A rise in application pressure in cavity A causes the same action until an equal pressure is established in the brake chambers.

3. Releasing

When the application pressure in cavity A above the diaphragm is reduced, the brake chamber pressure in cavity C below the diaphragm forces the diaphragm up. This opens the exhaust port under the outer edge of the diaphragm (cavity B), permitting pressure in brake chambers (cavity C) to exhaust until a lower balanced pressure is reached. If the application pressure in cavity A is released entirely, the relay valve also releases all air pressure from the brake chambers, fully releasing the brakes.

RELAY VALVE SERVICEABILITY TESTS

1. Operating Test

With the air brake system fully charged, apply brakes and make sure rear wheel brakes apply promptly. Release brakes and make sure air pressure is quickly exhausted from the exhaust port of the relay valve.

2. Leakage Tests

a. With brakes released, cover exhaust port with soap suds. Leakage in excess of 1-inch bubble

in one second is not permissible. Leakage is caused by supply valve not seating properly.

b. With brakes applied, cover exhaust port with soap suds. Leakage in excess of a 1-inch bubble in one second is not permissible. Leakage is caused by supply valve not seating properly.

c. If leakage is caused by diaphragm, both diaphragm and diaphragm seat should be wiped clean with gasoline. If leakage is caused by supply valve, valve must be removed and cleaned, or replaced with a new part.

RELAY VALVE REPLACEMENT

1. Removal

Exhaust air pressure from system. Disconnect air lines from valve, remove mounting bolts, then remove valve assembly from vehicle. Remove stop light switch and tee fitting from top of valve.

2. Installation

Install tee fitting and stop light switch on top of valve. Mount valve on frame and tighten mounting bolts firmly. Connect air lines to valve. Build up air pressure in system, then test valve as previously directed under "Serviceability Tests."

RELAY VALVE DISASSEMBLY (Fig. 9)

1. Remove four bolts and lock washers attaching adapter to valve body. Remove adapter and gasket.

2. Remove nuts and lock washers from six studs attaching valve cover to valve body. Remove cover, diaphragms, diaphragm ring, diaphragm grommets (at passage D), and diaphragm guide from valve body. Remove dampener ring from diaphragm guide.

3. Remove supply valve cap nut from bottom of valve body. Remove supply valve spring and supply valve from valve body.

INSPECTION

1. Thoroughly clean all parts in a suitable cleaning fluid.

2. Examine diaphragms for cracking, stretching, or deterioration. Replace if not in good condition.

3. Examine diaphragm seat at top of valve body. Seat must be smooth and free from scratches or corrosion. If only slightly scratched or corroded, seat may be repaired by lapping on a flat surface covered with fine aluminum oxide abrasive cloth.

4. Examine supply valve and supply valve seat in body. If valve or seat are scratched or worn, replace with new parts. To replace seat, press old seat out of body and press new seat into place, using new grommet under seat.

AIR BRAKES

NOTE: When necessary to replace supply valve seat, it normally is necessary that the new seat be larger in diameter than the one that was removed to insure a good fit; seats which are .005", .010", and .015" oversize are available. Make sure the seat enters straight and is fully seated. CAUTION: Do not damage sharp edge of seat which is contacted by supply valve.

5. Check condition of diaphragm guide dampener ring. When lying on a flat surface, the ends of the ring should not be in line like a piston ring; the ring must be twisted so one end is 3/16" higher than the other.

RELAY VALVE ASSEMBLY (Fig. 9)

1. Lay valve body on bench, bottom side up. Insert long end of supply valve through valve seat and position valve on seat. Place supply valve spring on valve, then install supply valve cap nut. Tighten cap nut firmly.

2. Turn assembly over. Install dampener ring on diaphragm guide, then install guide in body and over supply valve stem, making sure dampener ring enters bore in body.

3. Place diaphragm grommet having smallest diameter in valve body around passage D. Place diaphragm ring over studs in valve body, with small bleed hole in ring aligned with passage D.

4. Place other grommet on diaphragm ring around bleed hole; then place diaphragms over studs with large holes in diaphragms aligned with bleed hole in diaphragm ring.

5. Install valve cover on studs with passage D in cover aligned with passage D in valve body. Install lock washers and nuts on studs and tighten evenly and firmly.

6. Install adapter on side of valve body, using a new adapter gasket. Tighten adapter attaching bolts firmly.

BRAKE CHAMBERS

An air brake chamber is mounted at each wheel and connected to air system as shown in Air Line Diagram at beginning of this group. Brake chamber used at front brakes is illustrated in figure 10; no boot is used on rear brake chamber, but a push rod seal washer and spring are used inside the non-pressure plate. Both front and rear brake chambers have stud type mountings as shown.

The purpose of the brake chambers is to convert the energy of compressed air into the mechanical force and motion necessary to operate the mechanical brake assemblies at each wheel. Brake chamber consists essentially of a pressure plate, non-pressure plate, diaphragm, push rod,

and spring. The yoke on the push rod connects the push rod to a slack adjuster, mounted on brake camshaft.

OPERATION (Fig. 10)

As air pressure enters the brake chamber behind the diaphragm, the diaphragm forces the push rod outward, thus applying force to slack adjuster which rotates brake camshaft, applying brakes. When air pressure is released from the brake chamber, the brake shoe return springs and the push rod spring return the brake shoes, brake camshaft, slack adjuster, push rod, and diaphragm to released position. Due to the extreme sensitivity of the diaphragm, the push rod responds to the slightest variation of air pressure delivered to the brake chamber. This permits the driver to apply or release brakes as rapidly or as gradually as various road or operating conditions warrant.

BRAKE CHAMBER SERVICEABILITY TESTS

1. Operating Test

Apply brakes and see that the brake chamber push rods move out promptly without binding. Release brakes and see that they return to released position promptly without binding.

2. Leakage Tests

a. With brakes fully applied, coat with soap suds the bolting flanges holding the diaphragm in place between the pressure plate and the non-pressure plate. No leakage is permissible. If leakage is evident, tighten flange bolts. All flange bolts must be tightened evenly and only sufficiently

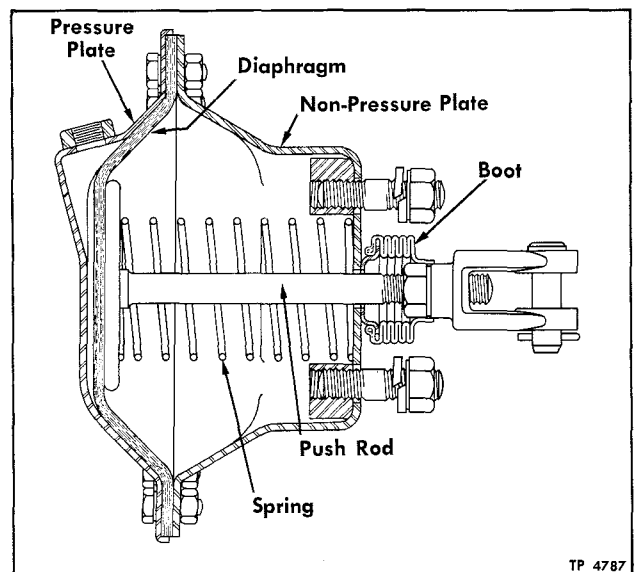


Figure 10—Brake Chamber (Front Shown)

AIR BRAKES

to prevent leakage, otherwise the diaphragm will become distorted and premature failure will result.

b. With brakes fully applied, check for leakage through the diaphragm by coating the push rod boot and the drain holes in the non-pressure plate with soap suds. No leakage is permissible. If leakage is evident, replace diaphragm.

3. Check Push Rod Travel

Check push rod travel by holding a rule alongside the push rod while brakes are applied and released. If travel is approaching maximum dimension given in figure 1, adjust as previously described under "Brake Adjustments" in this section.

BRAKE CHAMBER REPLACEMENT

1. Removal

Disconnect air line. Disconnect push rod yoke from slack adjuster. Remove mounting nuts and remove brake chamber.

2. Installation

Mount brake chamber in position and connect air line. Connect push rod yoke to slack adjuster. Adjust brakes as previously directed under "Brake Adjustment." Apply brakes and make sure push rods at front brakes are correct length. Angle formed by push rod and slack adjuster should be slightly greater than 90 degrees with brakes released. If necessary, adjust push rod length by screwing yoke onto or off of push rod. Push rod must not extend through yoke far enough to interfere with slack adjuster. Test brake chamber as previously directed under "Serviceability Tests."

BRAKE CHAMBER DISASSEMBLY

Before disassembling brake chamber, mark the pressure plate and the non-pressure plate so they may be reassembled with the air inlet opening in correct position. Disassemble brake chambers as follows:

Front (Fig. 10)

1. Remove nuts and bolts clamping the outer edge of diaphragm between pressure plate and non-pressure plate. Remove pressure plate and diaphragm.

2. Remove yoke, lock nut, and boot from push rod, then remove push rod and spring from non-pressure plate.

Rear

1. Remove nuts and bolts clamping the outer edge of diaphragm between pressure plate and non-pressure plate. Remove pressure plate and diaphragm.

2. Unscrew push plate from push rod and remove push rod, diaphragm spring, seal washer spring, and seal washer.

BRAKE CHAMBER INSPECTION

1. Clean all metal parts thoroughly, using a suitable cleaning fluid.

2. Examine diaphragm and replace with new part if any signs of wear or deterioration are evident. Diaphragms should be replaced every 50,000 miles, or at least every year.

3. Replace push rod if bent or distorted.

4. Examine push rod spring and replace if weak or broken. When replacing spring, make sure new spring has the same tension as the spring in the brake chamber on the opposite wheel, otherwise, unbalanced braking may result.

5. Replace push rod boot (front only) if deteriorated.

BRAKE CHAMBER ASSEMBLY

Front (Fig. 10)

1. Place push rod and spring in non-pressure plate, install boot on push rod and non-pressure plate, and install lock nut and yoke on push rod.

2. Place diaphragm on pressure plate. Position pressure plate and diaphragm on non-pressure plate, being sure the air inlet opening in the pressure plate is in proper relation to the mounting studs as marked before disassembly.

3. Install bolts and nuts holding diaphragm between plates. It is important that all bolts be tightened evenly and not excessively. Tighten bolts only sufficiently to insure an airtight seal, but not enough to distort the diaphragm.

Rear

1. Insert push rod through non-pressure plate. Place seal washer, seal washer spring, and diaphragm spring over push rod, then install push plate on push rod. Tighten push plate firmly onto push rod and stake in place.

2. Complete the assembly as directed in steps 2 and 3 under "Front."

SLACK ADJUSTERS

Slack adjusters function as adjustable levers and provide a quick and easy method of adjusting the brakes to compensate for normal lining wear. Positive locking type slack adjusters are used at front and rear brakes. Internal construction of both front and rear slack adjusters is as shown in figure 11; however, lever arms (body) may be offset or curved.

Slack adjuster consists basically of a hardened steel gear, which is splined to the brake camshaft, a brake lever (body), and a hardened steel worm which is mounted in the lever above the gear and meshes with the teeth in the gear. Turning the worm shaft causes rotation of the camshaft in relation to the brake lever. During brake opera-

AIR BRAKES

tion, the entire slack adjuster rotates bodily with the camshaft. As the brake chamber push rod reaches its maximum travel due to normal lining wear, turning worm shaft rotates lever back to original setting.

SLACK ADJUSTER SERVICEABILITY TEST

Adjust brakes as previously directed under "Brake Adjustment" in this section, then carefully measure brake chamber push rod travel as brakes are applied. Make several full brake applications and again measure push rod travel. Push rod travel should be the same as it was immediately after adjustment. If push rod travel increases, or if difficulty is experienced in keeping the brakes adjusted in service, the slack adjuster must be overhauled or replaced.

SLACK ADJUSTER REPLACEMENT

Removal

1. Remove clevis pin attaching slack adjuster to brake chamber push rod.
2. Remove snap ring (front) or bolt and washers (rear) securing slack adjuster on camshaft. Slide slack adjuster off end of shaft.

Installation

1. If a new slack adjuster is being installed, make sure it is the same size and type as the one removed. Slide slack adjuster onto camshaft and attach with bolt and washers or with snap ring.
2. Connect brake chamber push rod to slack adjuster, using clevis pin and cotter pin.
3. Lubricate slack adjuster as directed in LUBRICATION (SEC. 13).
4. Adjust brakes as previously directed under "Brake Adjustments."

SLACK ADJUSTER DISASSEMBLY (Fig. 11)

1. Remove dirt and grease from outside of unit by washing in a suitable cleaning fluid.
2. Cut off riveted ends of rivets attaching cover plates to body. Drive out rivets and remove cover plates.
3. Remove welch plug from end of worm shaft bore. Insert a flat end punch into the worm shaft bore and drive worm shaft out of body and worm.
4. Remove lock sleeve and spring from worm shaft. Remove gear and worm from slack adjuster body. Remove lubrication fitting.

INSPECTION AND REPAIR

1. Wash parts in cleaning fluid and wipe dry.
2. Inspect worm and gear and replace with new parts if chipped or broken teeth are evident.
3. Inspect worm shaft for wear. Make sure corners on hex end are not rounded.

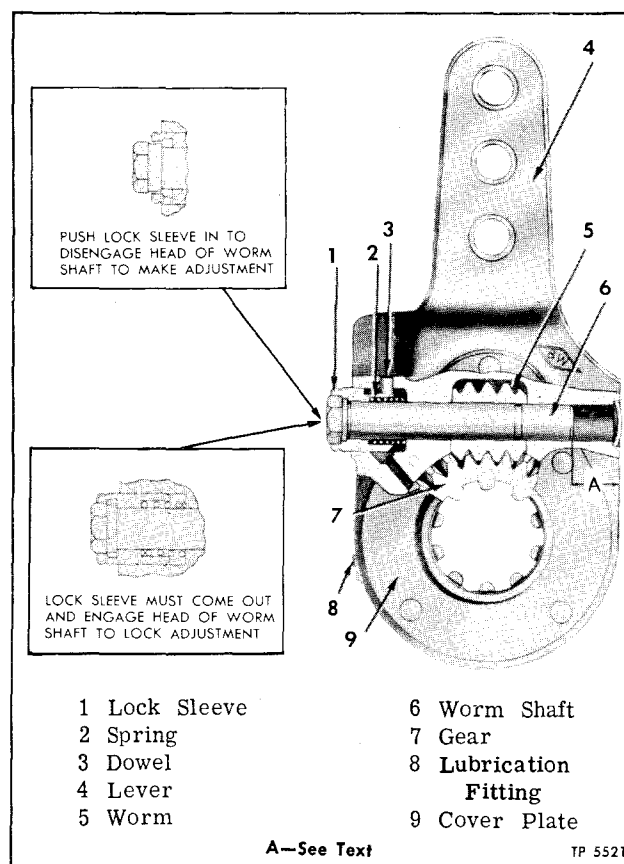


Figure 11—Slack Adjuster

4. Inspect bushing in lever arm. If worn, out-of-round, or otherwise damaged, it must be replaced. To replace bushing, press old bushing out and press new bushing into place. Bushing must be reamed after installation to .501" - .503".

5. Examine lock sleeve for cracks or other damage. Replace if necessary.

6. Examine lever (body) for cracks or distortion. If lever is damaged in any way, a new body and bushing assembly must be used.

SLACK ADJUSTER ASSEMBLY (Fig. 11)

1. Place worm and gear assembly in position in body.
2. Place lock sleeve over worm shaft, with socket-like end of sleeve at hex end of shaft. Place lock spring in recess formed by sleeve and shaft.
3. Enter small end of worm shaft through hole in body and worm. Press worm shaft into worm and body, making sure the groove in lock sleeve is aligned with pin in body. Press shaft in until distance from small end of shaft to edge of body (A, fig. 11) is as follows: Front - 5/8"; Rear - 9/16". Install welch plug in worm shaft bore.

AIR BRAKES

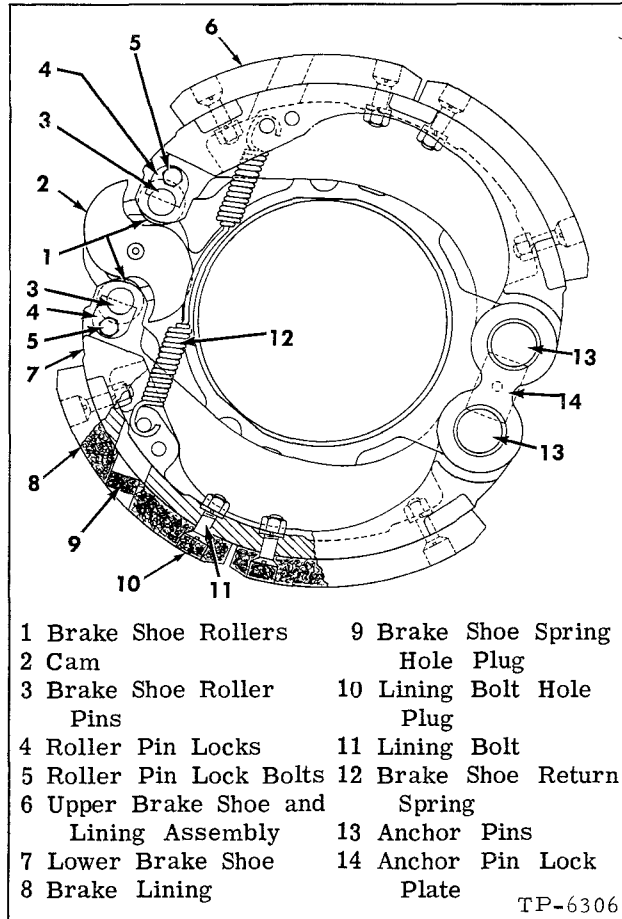


Figure 12—Front Brake Shoes Installed

4. Position cover plates on body and attach with new rivets. Covers must be flat and in good contact with body after riveting.

5. Install lubrication fitting in body. Connect a grease gun to fitting and force grease into slack adjuster until it is completely filled. Refer to LUBRICATION (SEC. 13) for type of lubricant.

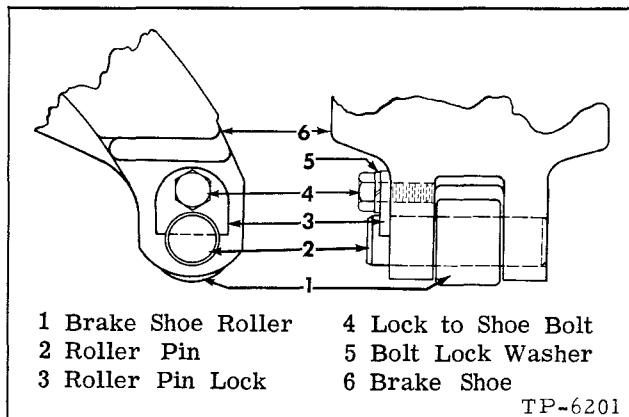


Figure 13—Brake Shoe Roller Pin Lock Installation

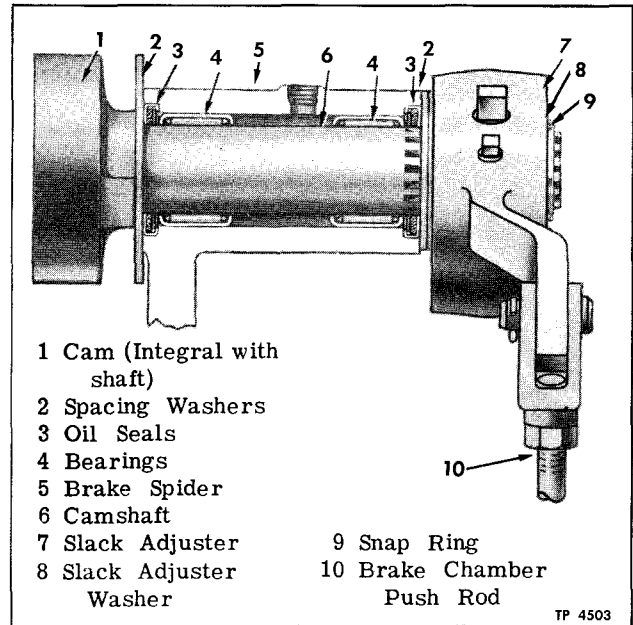


Figure 14—Front Camshaft and Slack Adjuster Mounting (Typical)

FRONT BRAKE SHOES, LININGS, AND CAMSHAFTS

SHOES AND LININGS (Fig. 12)

Brakes at each front wheel have two shoes which pivot on anchor pins at one end and are expanded at the other end during brake application by constant lift S-type cams. Brake shoe return springs hold shoe ends firmly against cam as shown in figure 12. Two-piece block type lining is bolted to each shoe. Holes through linings and shoes, adjacent to return spring pins, are provided to facilitate removing and installing springs.

Cam end of each shoe is equipped with a roller which forms the contact between shoe and cam. Rollers are mounted on pins which are retained in shoes by lock plates and cap screws as shown in figure 13. Anchor pin ends of shoes are equipped with replaceable bushings.

ANCHOR PINS (Fig. 12)

Anchor pin end of each shoe fits between brackets at brake spider, and is retained by straight type anchor pin. Both anchor pins are held in place by a lock plate which fits into notches near ends of pins and is attached to brake spider by a cap screw. Anchor pins are drilled and threaded for lubrication fittings.

CAMSHAFTS (Fig. 14)

Front brake camshafts are mounted in needle type roller bearings in brake spiders. Lubrication fittings provide method of lubricating bearings. Lubricant is retained by seals, installed in brake spider as shown in figure 14.

AIR BRAKES**FRONT BRAKE SHOE AND CAMSHAFT REMOVAL (Figs. 12 and 14)**

1. Jack up axle and remove wheel and brake drum. Remove hub as directed in "HUBS AND BEARINGS" in WHEELS, HUBS, AND TIRES (SEC. 19).

2. Drive plugs out of lining at one end of shoe return springs. Using hooked tool through hole in lining and shoe, unhook springs from pin. Remove springs from pin at other shoe. Tag or mark shoes so they may be reinstalled in their original position.

3. Remove anchor pin lock plate. Drive anchor pins out of brake spider and shoes. Lift shoes off brake spider.

4. To remove camshaft, disconnect brake chamber push rod from slack adjuster; remove snap ring and washer attaching slack adjuster on camshaft; pull slack adjuster off shaft. Pull camshaft out of brake spider, stripping washers off shaft as shaft is removed.

INSPECTION

1. Check anchor pins and bushings for wear in accordance with dimensions listed in "Specifications" at end of this group. Replace with new parts any that are excessively worn. If brake shoe bushings are replaced, burnish after installation.

2. Examine camshaft needle bearings and seals. Use new parts if there is any indication of wear or distortion. New seals should be soaked in oil until soft and pliable, and should be installed with tapered edge out to permit installing camshaft without damaging seals.

3. Check fit of shoe rollers on roller pins. If excessive looseness is evident, remove pins and rollers and check for wear. Replace worn parts. Lubricate roller pins before installing.

4. Check tension of brake shoe return springs. Replace if weak or broken.

5. Check thickness of brake lining at center of shoe. If worn to 5/16" thickness, lining must be replaced. When new brake linings are used, make sure they are bolted securely to shoe. New lock washers should be used and nuts tightened to 20-25 foot-pounds. A .006" feeler must not enter between lining and shoe at any point. Drive lining plugs into bolt holes when installation is completed. Make sure roller in shoe is standard size when new linings are installed.

6. If brake drums have been machined over-size, refer to instructions under "Brake Drums" later in this section.

FRONT CAMSHAFT AND BRAKE SHOE INSTALLATION (Figs. 12 and 14)

1. Work lubricant into camshaft bearings. Install new seals if necessary.

2. Place washer on camshaft and insert shaft through brake spider, being careful not to damage seals.

3. Install brake shoes in positions from which they were removed by inserting anchor pin ends of shoes between brackets on brake spider. Coat anchor pins with lubricant and insert through brake spider and shoes; pins must be installed with notches at inner end and facing each other. Secure pins in place with lock plate and cap screw.

4. Apply lubricant to brake shoe roller pin with oil can. Hook one end of brake shoe return springs on pin at one shoe. Stretch springs and hook onto pin in opposite shoe, using tool through holes in lining and shoe. Drive lining plugs into holes after hooking springs.

5. Place washer over inner end of camshaft, install slack adjuster on camshaft, and secure in place with washers and snap ring. Back off slack adjuster adjusting screw until shoe rollers are at lowest points on cam.

6. Install hub, drum, and wheel and adjust wheel bearings as directed in "HUBS AND BEARINGS" in WHEELS, HUBS, AND TIRES (SEC. 19).

7. Connect slack adjuster to brake chamber push rod and adjust push rod travel as previously instructed under "Brake Adjustment" in this section.

8. Lubricate slack adjuster, camshaft bearings, and anchor pins as directed in LUBRICATION (SEC. 13).

REAR BRAKE SHOES, LININGS, AND CAMSHAFTS**SHOES AND LININGS (Fig. 15)**

Brakes at each rear wheel have four shoes mounted side by side in pairs. Shoes pivot on anchor pins at one end and are expanded at the other end during brake application by two constant lift S-type cams. Brake shoe return springs hold shoe ends firmly against cams as shown in figure 15. Two-piece block type lining is bolted to each shoe. Holes through linings and shoes, adjacent to return spring pins, are provided to facilitate removing and installing springs.

Cam end of each shoe is equipped with a roller which forms the contact between shoe and cam. Rollers are mounted on pins which are retained in shoes by lock plates and cap screws as shown in figure 13. Anchor pin ends of shoes are equipped with replaceable bushings.

ANCHOR PINS (Fig. 15)

Anchor pins attach one end of each shoe to brake spider. Each anchor pin is installed through brake spider and carries a brake shoe on each end. Anchor pins are secured in brake spider by set screws which are threaded through spider and

AIR BRAKES

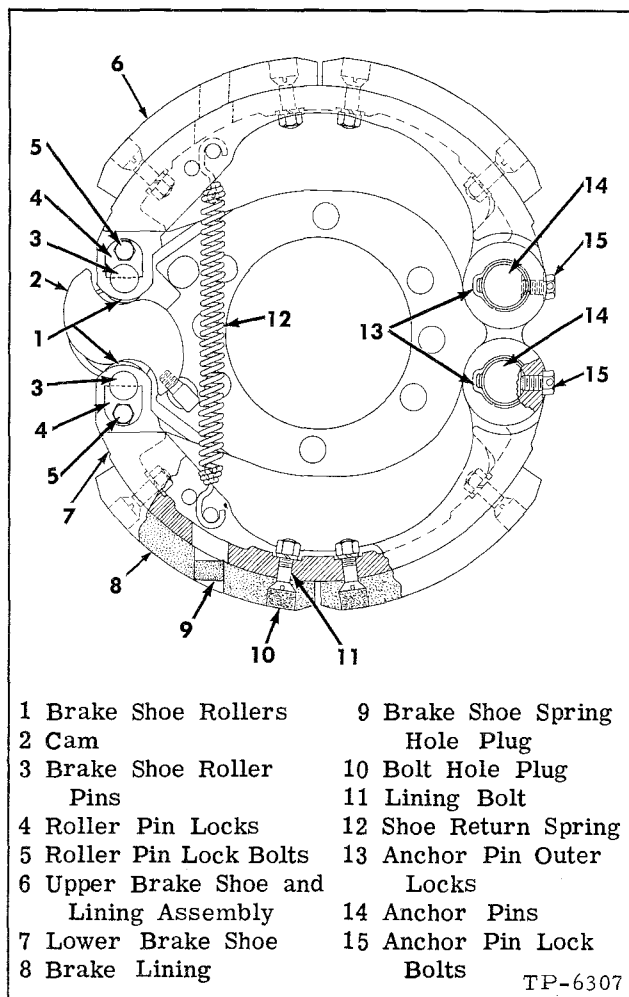


Figure 15—Rear Brake Shoes Installed

bear against flat spots at center of pins. Shoes are held in place on anchor pins by flat washers and locks which fit into grooves in ends of pins. Anchor pins are drilled and threaded for lubrication fittings.

CAMSHAFTS (Fig. 16)

Inner end of each camshaft is carried in needle type roller bearings in a self-aligning bracket attached to spring seat and brake chamber bracket. Outer end is bushing mounted between cams at brake spider. Lubrication fittings are provided for lubricating bearings and bushings. Lubricant is retained by seals installed as shown in figure 16.

REAR BRAKE SHOE REMOVAL (Fig. 15)

1. Jack up rear end of vehicle and remove rear wheels and brake drum. Remove axle shaft as directed in REAR AXLE (SEC. 2). Remove hub as directed in "HUBS AND BEARINGS" in WHEELS, HUBS, AND TIRES (SEC. 19).

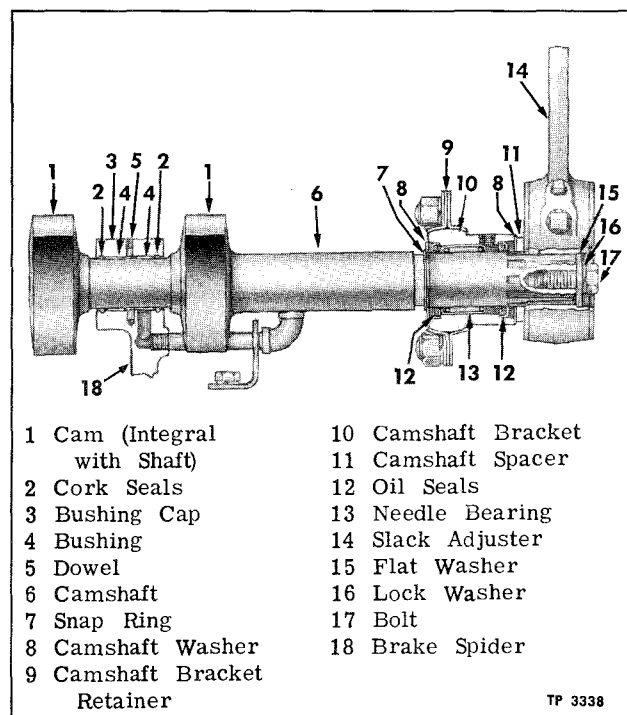


Figure 16—Rear Camshaft and Slack Adjuster Mounting (Typical)

2. Drive plugs out of lining at one end of shoe return spring. Using hooked tool through hole in lining and shoe, unhook spring from pin. Remove spring from pin at other shoe. Tag or mark shoes so they may be reinstalled in their original position.

3. Remove anchor pin outer locks and washers, then remove outer shoes from anchor pins.

4. Remove anchor pin inner locks and washers, then remove inner locks from anchor pins.

5. Remove lock wire from anchor pin set screws, loosen set screws, and remove anchor pins from brake spider.

REAR CAMSHAFT REMOVAL (Fig. 16)

1. Perform step 1 under "Rear Brake Shoe Removal."

2. Unhook brake shoe return springs as directed in step 2 under "Rear Brake Shoe Removal."

3. Remove two bolts attaching camshaft bushing cap to brake spider and remove cap.

4. Disconnect slack adjuster from brake chamber push rod. Remove bolt and washers attaching slack adjuster to camshaft and remove slack adjuster.

5. Remove nuts and lock washers attaching camshaft bracket retainer to spring seat. Lift camshaft and inner bracket as an assembly from axle. Slide inner bracket and bearing assembly off camshaft.

AIR BRAKES**REAR BRAKE SHOES AND CAMSHAFT INSPECTION**

1. Check anchor pins and anchor pin bushings (in shoes) for wear in accordance with dimensions listed in "Specifications" at end of this group. Replace with new parts any that are worn excessively. If bushings are replaced, they must be burnished to correct size after installation. Make sure that lubricant passages in anchor pins are open.

2. Examine needle bearings, bushings, and seals in camshaft bracket and brake spider. Use new parts if there is any indication of wear or distortion. New seals used in camshaft bracket should be soaked in oil until soft and pliable before installing.

3. Check fit of shoe rollers on roller pins. If excessive looseness is evident, remove pins and rollers and check for wear. Replace worn parts. Lubricate roller pin before installing.

4. Examine camshafts for cracks, distortion, or wear at the bearing surfaces and cams. Replace if necessary.

5. Check thickness of brake lining at center of shoe. If worn to 5/16" thickness, lining must be replaced. When new brake linings are used, make sure they are bolted securely to shoe. New lock washers should be used and nuts tightened to 20-25 foot-pounds. A .006" feeler must not enter between shoe and lining at any point. Drive lining plugs into bolt holes when installation is completed. Make sure roller in shoe is standard size when new linings are installed.

6. If brake drums have been machined oversize and oversize linings used, refer to instructions under "Brake Drums" later in this section.

7. Check tension of brake shoe return springs. Replace if weak or broken.

REAR CAMSHAFT INSTALLATION (Fig. 16)

1. Work lubricant into camshaft needle bearings in camshaft inner bracket, and install new seals if necessary. Coat bushings in brake spider and bushing cap with lubricant, and install new cork seals in spider and cap.

2. Place snap ring and washer over splined end of camshaft, then install inner bracket and bearing assembly on shaft. Make sure snap ring is seated in groove in camshaft.

3. Position camshaft and inner bracket assembly on axle with inner bracket retainer in place on studs and with bearing surface between cams in place on brake spider.

4. Install nuts and lock washers on bracket retainer studs, but do not tighten. Install bushing cap on brake spider and attach with two bolts. Wire bolt heads together after tightening.

5. Install washer and spacer on inner end of camshaft, then install slack adjuster and connect

to brake chamber push rod.

6. If brake shoes were removed, install shoes as directed under "Rear Brake Shoe Installation." If shoes were not removed, install brake shoe return springs, then perform steps 8 and 9 under "Rear Brake Shoe Installation."

7. Apply brakes and release to assure proper alignment of camshaft bearing; firmly tighten camshaft inner bracket retainer nuts.

8. Adjust brakes as previously directed under "Brake Adjustment."

REAR BRAKE SHOE INSTALLATION (Fig. 15)

1. Coat anchor pins with lubricant recommended in LUBRICATION (SEC. 13). Lubricate brake shoe roller pins with oil.

2. Position inner shoes and install anchor pins. Anchor pins must be installed with drilled end toward center of vehicle and with milled flat adjacent to lock screw holes in brake spider.

3. Install washers and locks on inner ends of anchor pins. Hook one end of brake shoe return spring on pin at one shoe. Stretch spring and hook onto pin in opposite shoe, using tool through holes in lining and shoe. Drive lining plugs into holes in lining after hooking spring.

4. Install outer shoes on anchor pins and install washers and locks on anchor pins.

5. Tighten anchor pin set screws and wire set screw heads together.

6. Install return spring on outer shoes in same manner as described in step 3 above.

7. Back off slack adjuster adjusting screw until shoe rollers are at lowest point on cams.

8. Clean and lubricate bearings, install hub and bearings, install brake drum and wheels, and adjust wheel bearings as directed in "HUBS AND BEARINGS" in WHEELS, HUBS, AND TIRES (SEC. 19).

9. Adjust brakes as previously directed under "Brake Adjustment" in this section.

BRAKE DRUMS

When brake drums become scored, they may be refaced by machining or grinding. To compensate for increased inside diameter of refaced drums, 1/16" and 1/8" oversize brake linings are available from the lining manufacturers. When drums are refaced, they should be machined in increments of 1/16" (.0625") and linings oversize the amount machined from the drum installed.

Satisfactory operation with oversize linings will be obtained until the lining becomes worn sufficiently to permit the brake shoe roller to pass the high point on the cam without effectively applying the brakes. When oversize linings become worn approximately 50%; oversize rollers should be installed in shoes. Shoe rollers are

AIR BRAKES

available in standard and three oversizes, each size for use with certain oversize linings and drums as explained below:

NOTE: To avoid misunderstanding the term "oversize" as applied to linings and drums, the following example applies:

1/8" Oversize Brake Drum

Inside diameter (I.D.) of the brake drum has been increased 1/8"; that is, 1/16" of metal has been removed around the circumference of the drum.

1/8" Oversize Lining

Linings are 1/16" thicker than standard, thus the total increased thickness of linings on both shoes compensates for the 1/8" increased diameter of drum.

Standard Rollers (1.250" O.D.)

Standard rollers are used when installing standard linings with standard drums, 1/16" oversize drums, and 1/8" oversize lining with 1/8" oversize drums. If the drums have been previously refaced and oversize rollers installed, when lining becomes worn, the oversize rollers must be removed and standard rollers installed.

1/8" (1.375") Oversize Rollers

1/8" oversize rollers are used with the installation of standard lining with worn or trued drums which are 1/32" oversize. 1/8" oversize rollers should be installed, then the lining circle ground to the drum diameter.

1/4" (1.500) Oversize Rollers

When 1/16" oversize linings have been installed with 1/16" oversize drums and standard rollers, the standard rollers should be removed and 1/4" oversize rollers installed before the lining becomes worn to a point where the brake cam is no longer effective with the standard rollers.

1/2" (1.750") Oversize Rollers

When 1/8" oversize linings and 1/8" oversize drums have been used, the standard rollers should be removed when the linings become worn approximately 50% and the 1/2" oversize rollers installed.

IMPORTANT: Whenever installing new lining, regardless of the size, make sure standard rollers are installed in shoes, except as explained under "1/8" Oversize Rollers" above.

Brake drums should never be machined to more than 1/8" beyond original diameter.

Air Compressor and Governor

AIR COMPRESSOR

Air compressor is a two-cylinder, single-acting, reciprocating type unit with unloading type head. Compressor is flange mounted to the engine gear train cover, lubricated by the engine lubrication system, and the cylinder head is cooled by the engine cooling system.

Compressor has a rated capacity of seven and one-quarter cubic feet per minute, based on its piston displacement when running at a speed of 1250 rpm.

COMPRESSOR DRIVE AND LUBRICATION

An internal fiber toothed hub is keyed to front end of compressor crankshaft and secured by a nut and cotter pin (fig. 17). An internal toothed fiber drive disc is attached to engine camshaft gear by four cap screws. A drive coupling with external teeth at each end is carried in the internal teeth of the hub and drive disc, transmitting power from disc to compressor crankshaft.

Oil, under pressure from engine lubrication system, enters drilled crankshaft through crankshaft end cover and is forced through crankshaft and drilled connecting rods, lubricating bearings, piston pins, and pistons. Oil returns to engine through an oil return line connected to drain hole in compressor crankcase cover.

COMPRESSOR AIR INTAKE

Air compressor has forced air intake system. Compressor air inlet manifold is connected by a tube to the left rear hand hole cover on the engine air box. When each compressor piston is at the bottom of its stroke and the air intake ports in the cylinder wall are uncovered, air pressure in the engine air box forces air into the compressor cylinder. This tends to supercharge the compressor, since a greater volume of air flows into the compressor cylinders than when the conventional atmospheric air intake system is used. The use of this type air intake system also eliminates the necessity of an air compressor air cleaner, since the air in the engine air box is cleaned by the engine air intake system air cleaners.

COMPRESSOR OPERATION

Air compressor crankshaft turns continuously while engine is running, but actual compression of air is controlled by the compressor governor.

Acting in conjunction with compressor unloading mechanism, governor controls compression of air by loading or unloading compressor when pressure in air system reaches the desired maximum or minimum. Air line connections at compressor and governor are illustrated in Air Line Diagram at beginning of this group.

OPERATION WITH UNLOADING VALVES

CLOSED (COMPRESSING) (Figs. 18 and 19)

During the downstroke of each piston, a partial vacuum is created above the piston. As the piston nears the bottom of its stroke, it uncovers intake ports in the side of the cylinder wall. Air from the engine air box is then forced into the cylinder through the inlet ports.

As each piston begins its upstroke, it covers the air intake ports in the cylinder wall and the air which has entered the cylinder is trapped above the piston. As the piston continues its upstroke, the air above the piston is compressed.

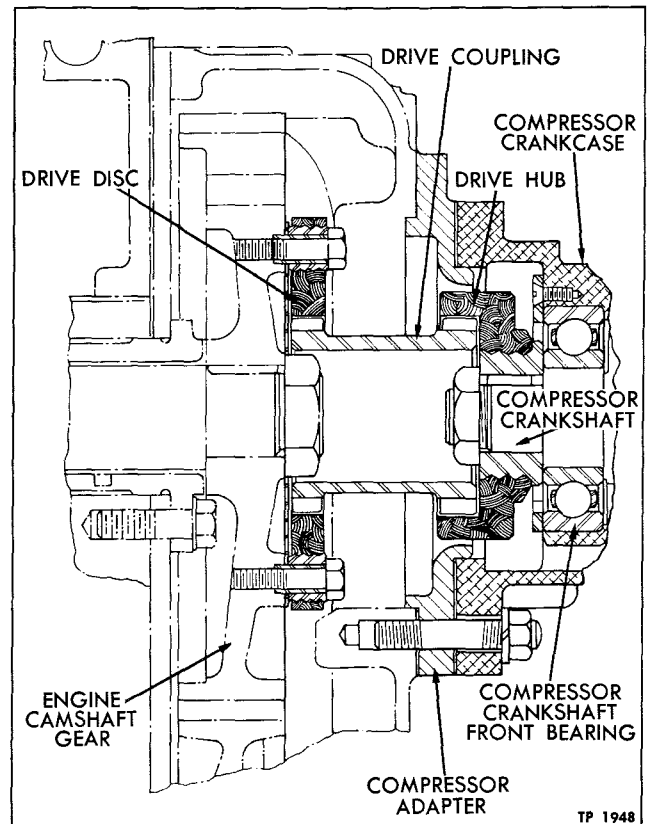
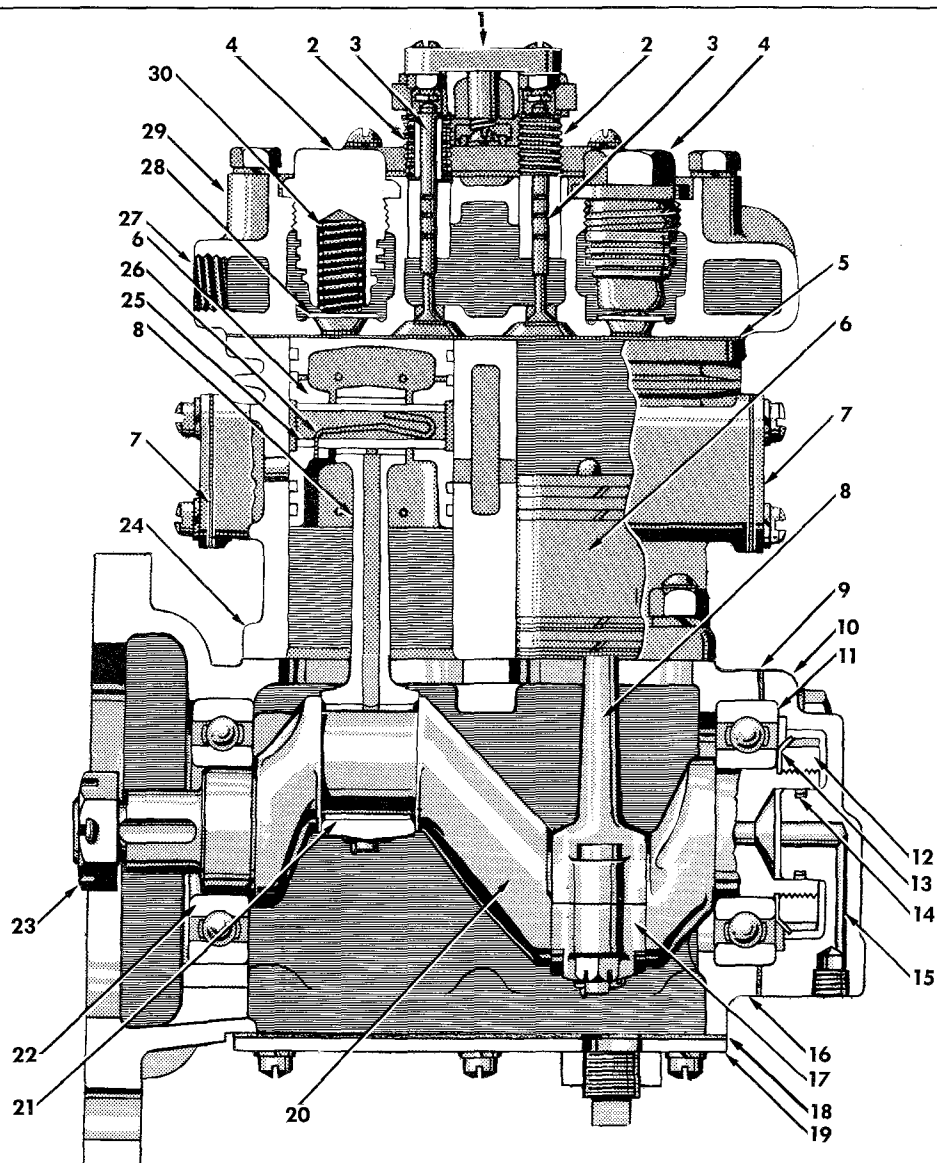


Figure 17—Air Compressor Drive (Typical)

AIR COMPRESSOR AND GOVERNOR



- | | | |
|---------------------------|-------------------------------------|-----------------------------|
| 1 Unloading Valve Lever | 11 Crankshaft Rear Bearing | 21 Connecting Rod Bearing |
| 2 Unloading Valve Spring | 12 Crankshaft Rear Bearing Nut | 22 Crankshaft Front Bearing |
| 3 Unloading Valve | 13 Crankshaft Rear Bearing Nut Lock | 23 Crankshaft Nut |
| 4 Discharge Valve Cap Nut | 14 Crankshaft Seal Ring | 24 Cylinder Block |
| 5 Cylinder Head Gasket | 15 Oil Inlet Passage | 25 Piston Pin |
| 6 Piston | 16 Crankcase | 26 Piston Pin Lock |
| 7 Blanking Cover | 17 Connecting Rod Cap | 27 Water Line Connection |
| 8 Connecting Rod | 18 Bottom Cover Gasket | 28 Discharge Valve |
| 9 Rear End Cover Gasket | 19 Crankcase Bottom Cover | 29 Cylinder Head |
| 10 Rear End Cover | 20 Crankshaft | 30 Discharge Valve Spring |

TP 4265

Figure 18—Sectional View of Air Compressor

AIR COMPRESSOR AND GOVERNOR

When air pressure in the cylinder becomes greater than the pressure in the cylinder head above the discharge valve, it forces the discharge valve off its seat and passes out through the discharge port into the air line leading to the air tank.

As the piston starts its downstroke, the discharge valve returns to its seat, preventing the compressed air from returning to the cylinder and the intake and compression cycle is repeated.

OPERATION WITH UNLOADING VALVES OPEN (NOT COMPRESSING) (Figs. 18 and 19)

When air pressure in the air system reaches the maximum pressure for which the governor is set, air pressure passes through the governor into the cavity below the diaphragm in the compressor cylinder head, deflecting the diaphragm upward. Movement of diaphragm is transmitted through the diaphragm follower and dust guard to the lower end of the unloading valve lever. As the lower end of the valve lever is forced upward, lever pivots on lever pin and the upper end of the lever moves downward. Downward movement of the valve lever forces the unloading valves off their seats. With the unloading valves off their seats, the unloading cavity in the cylinder head forms a passage between the cylinders above the pistons. Thus during the upward stroke of each piston, air merely passes back and forth through this passage and compression is stopped.

When the air pressure in the air system is reduced to the governor cut-in setting, the governor releases the air pressure from the cavity below the diaphragm, the unloading valve springs return the unloading valves to their seats, and compression of air is resumed.

COMPRESSOR MAINTENANCE

It is important that the inspection and adjustments given below be made at intervals determined by severity of service.

1. Remove cylinder head and clean carbon away from discharge and unloader valves.
2. Check compressor discharge line. Make sure line is not choked with carbon.
3. Adjust clearance between top of unloading valves and bottom of adjusting screws to .010 to .015 inch.
4. Check compressor mounting bolts and tighten if necessary.
5. Oil unloading valve lever pin.
6. Remove diaphragm cover and inspect unloading diaphragms. Replace diaphragms if damaged.
7. Make sure water and air line connections are tight and not leaking.
8. When draining engine cooling system, be sure and remove drain plug from compressor cylinder head.

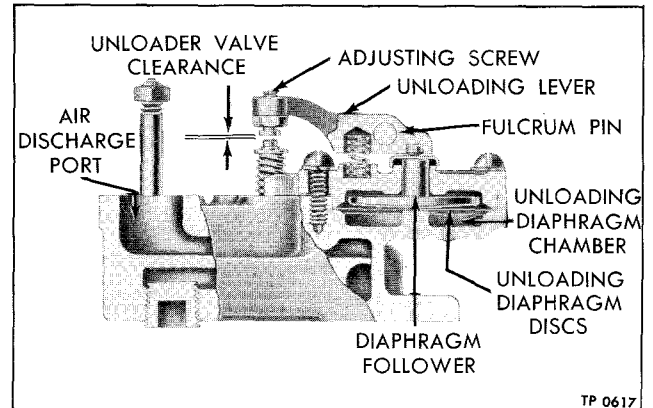


Figure 19—Air Compressor Cylinder Head

COMPRESSOR REPLACEMENT

REMOVAL

1. Drain cooling system.
2. Disconnect water, air, and oil lines from compressor.
3. Disconnect air inlet tube from air inlet elbow on compressor cylinder block.
4. Remove nuts from three studs attaching air compressor to gear train cover. Pull compressor straight off from studs and remove from vehicle. Remove compressor adapter from mounting studs.

INSTALLATION (Fig. 17)

1. Before installing compressor, examine hub on compressor crankshaft and drive disc on camshaft gear for worn or broken teeth. Check backlash between teeth in hub and teeth on drive coupling, also between teeth in drive disc and teeth on coupling. New limits are .000 to .001 inch backlash. If backlash is appreciably greater than this, disc or hub (or both) must be replaced.
2. Make sure mating surfaces of air compressor, air compressor adapter, and gear train cover are clean. Place new adapter to gear train cover gasket over mounting studs, install adapter, then place compressor to adapter gasket on studs.
3. Insert one end of drive coupling into hub on compressor crankshaft, then place compressor in position on gear train cover, guiding teeth on coupling into mesh with teeth in drive disc. Install nuts and lock washers on studs and tighten firmly.
4. Connect air inlet tube to air inlet elbow on side of cylinder block.
5. Connect oil, water, and air lines to compressor, using aviation type permatex on fittings.
6. Make sure plug is installed in cylinder head, then fill cooling system (refer to COOLING SYSTEM, SEC. 6).

AIR COMPRESSOR AND GOVERNOR

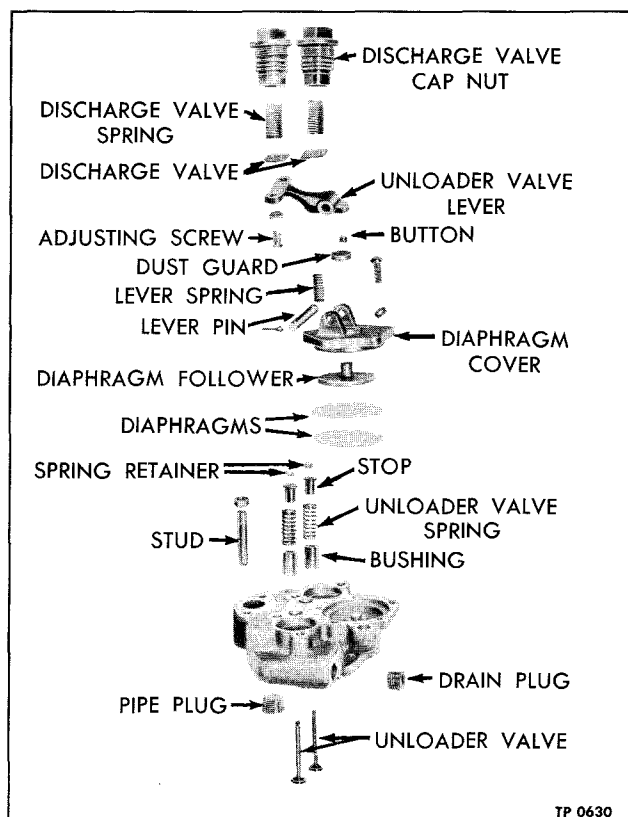


Figure 20—Compressor Cylinder Head Disassembled

COMPRESSOR DISASSEMBLY

The cylinder block, cylinder head, crankcase, and air inlet elbow are so designed that they may be assembled in different ways to meet installation requirements; therefore, these parts should be marked prior to disassembly so they may be assembled in correct relationship to each other. Remove air inlet elbow from side of cylinder block.

CYLINDER HEAD REMOVAL AND DISASSEMBLY (Fig. 20)

1. Remove nuts from all cylinder head studs and lift off cylinder head assembly. The cylinder head may have to be tapped lightly with a rawhide hammer to break the gasket joint. Scrape cylinder head gasket off cylinder head and cylinder block.
2. Remove cotter pins from unloading valve lever pin and drive out pin. Remove unloading valve lever, lever spring, and dust guard. Remove adjusting screws and lock nuts from lever.
3. Remove screws and lock washers attaching diaphragm cover to cylinder head. Lift off cover and remove diaphragm follower and two diaphragms.
4. Remove discharge valve cap nuts and lift out discharge valve springs. Invert head to allow

discharge valves to fall out.

5. Compress unloading valve springs and remove spring retainers, then remove springs and stops from valve stems. Remove unloading valves by pushing them out bottom of cylinder head.

PISTON AND CONNECTING ROD REMOVAL AND DISASSEMBLY (Fig. 18)

1. Before removing pistons, mark each piston so it may be installed in original position in proper cylinder. Connecting rods and caps are marked to show proper position of cap on rod.
2. Remove cover and gasket from bottom of crankcase.
3. Remove cotter pins and nuts from connecting rod bolts and remove connecting rod bearing caps and bearing inserts. Do not remove bolts from rods. Push pistons with connecting rods attached out top of cylinder block. Replace caps on rods with inserts in place to prevent damage to inserts. Temporarily install nuts on same bolts from which they were removed.
4. Remove piston rings from pistons. If pistons are to be removed from connecting rods, remove piston pin locks and press piston pins out of pistons and connecting rods.

CRANKSHAFT REMOVAL

1. Remove cotter pin and nut from forward end of crankshaft and pull drive hub off from shaft, using a suitable puller.
2. Remove nuts and lock washers from studs securing rear end cover to crankcase and remove end cover and gasket.
3. Remove nut and nut lock from rear end of crankshaft.
4. Press crankshaft and bearings out rear end of crankcase, then press bearings off crankshaft.

CYLINDER BLOCK REMOVAL (Fig. 18)

1. Remove nuts and lock washers attaching cylinder block to crankcase and remove cylinder block and gasket.

CLEANING AND INSPECTION OF COMPRESSOR PARTS

CLEANING

1. General

Thoroughly wash all parts in a suitable cleaning fluid to remove all traces of dirt, oil, or grease.

2. Cylinder Head

Soak cylinder head body in cleaning fluid to loosen carbon from discharge valve cavities and unloading valve cavity, and to loosen rust and scale. Use compressed air to blow dirt out of all cavities. Scrape carbon, dirt, or particles of old gasket from all surfaces.

AIR COMPRESSOR AND GOVERNOR**3. Discharge Valves**

If discharge valves are not worn excessively or damaged, they may be cleaned by lapping them on a piece of crocus cloth on a flat surface.

4. Oil Passages

Thoroughly clean all passages through crankshaft, connecting rods, crankcase, and rear end cover. If necessary, prod oil passages with a piece of wire, flush with cleaning fluid, and blow out with compressed air.

5. Cylinder Block

Soak cylinder block in cleaning fluid to loosen carbon and dirt from intake manifold and intake ports. Blow dirt out with compressed air.

6. Pistons

Scrape all carbon and dirt out of ring grooves in pistons. Make sure drain holes in oil ring grooves are open.

7. Ball Bearings

Immerse bearings in cleaning fluid, clean with a brush to remove old lubricant. Blow bearings dry with compressed air, then wrap in a clean cloth.

INSPECTION**1. Cylinder Head**

Inspect cylinder head body for cracks or breaks; replace head if any are found. Check condition of unloading diaphragm seat in diaphragm cavity. Replace cylinder head body if seat is damaged in any way. Inspect unloading valve seats in bottom of cylinder head. If seats are pitted or worn they must be reamed as directed later in this section under "Compressor Repair." Test cylinder head water jacket for leakage, using air pressure. Replace cylinder head body if leakage is evident.

2. Unloading Lever Pin

Check fit of unloading lever pin in unloading lever. If excessive play is evident, replace lever or pin, or both.

3. Unloading Diaphragms and Cover

Inspect diaphragms and replace if any signs of wear or cracking are present. Examine diaphragm seat on bottom of diaphragm cover. Lap seat or replace cover as necessary.

4. Unloading Valves and Bushings

Check fit of unloading valve stems in unloading valve bushings; valve stems must be a neat sliding fit in bushings. If excessive clearance is evident, check valve stems for wear. Wear of the valve stems must not exceed .002 inch. Wear may be checked by comparing the diameter of the valve stem where it engages the bushing with the diameter of the stem where it does not engage the bushing. If clearance between valve stems and bushings is excessive, valves, bushings, or both must be replaced as directed later under "Compressor Repair" in this section.

5. Discharge Valve Springs

Discard all used discharge valve springs and replace with new springs.

6. Discharge Valves and Seats

Inspect discharge valves and seats. If discharge valves are grooved deeper than .003 inch where they contact the seats, they must be replaced. Valves which are scratched or only slightly grooved may be repaired by lapping valves with a fine abrasive powder on a surface plate. If discharge valve seats are worn or pitted, they must be reconditioned as directed later under "Compressor Repair" in this section.

7. Crankcase and End Cover

Check crankcase and end cover for cracks or broken lugs. Replace with new parts if damaged. Check fit of oil seal ring in groove in rear end cover. Ring must be a neat fit in groove and must have .008 to .015 inch clearance at the gap when placed in the end bore of the crankshaft.

8. Crankcase Bearing Bores

Check fit of ball bearings in crankcase. Bearings must be a light press fit in bores. If crankcase bearing bores are worn or damaged, crankcase must be replaced.

9. Cylinder Block

If cylinder block is cracked or damaged in any way, it must be replaced. Examine cylinder bores for scoring, out-of-round, and taper. Bores may be checked for out-of-round and taper using an inside micrometer as shown in figure 21. Bores which are scored or out-of-round more than .003 inch, or tapered more than .003 inch must be re-bored, ground, or honed oversize. Pistons are available in .010, .020, and .030 inch oversize. Cylinder bores must be smooth, straight, and round, and must be finished with a 500 (or finer) grit hone. Clearance between piston and cylinder wall must not be less than .002 inch or more than .004 inch.

10. Pistons

Examine pistons for scoring, cracks, or damage of any kind. Measure outside diameter of piston with a micrometer and compare this measurement with inside diameter of cylinder bore. If piston is more than .004 inch smaller than the cylinder bore, piston must be replaced with an oversize piston.

11. Piston Pins

Check fit of piston pins in pistons and connecting rods. Pins must be a light press fit in pistons. If piston pin is loose in piston, the pin, piston, or both must be replaced. Check fit of piston pins in connecting rod bushings by rocking the pins in the bushings. If looseness is evident, replace the connecting rod bushings as directed later under "Compressor Repair" in this section. Discard all used piston pin locks.

AIR COMPRESSOR AND GOVERNOR

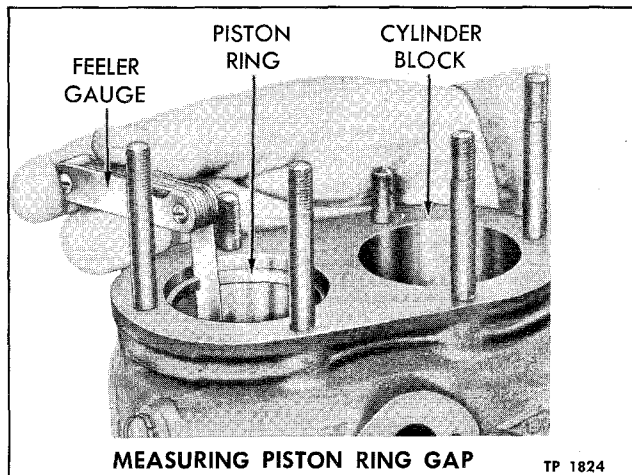
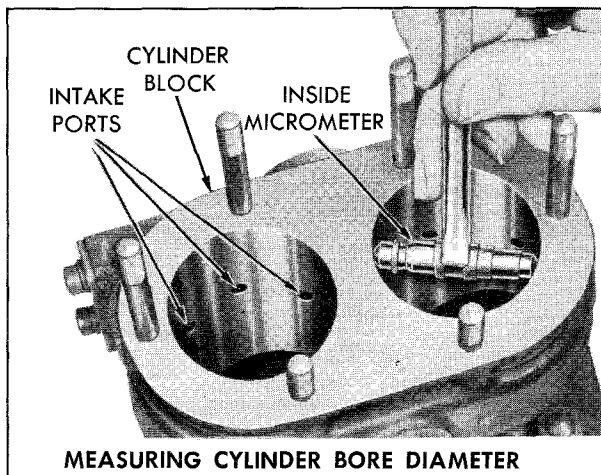


Figure 21—Compressor Cylinder Bore and Piston Ring Inspection

12. Piston Rings.

Check fit of piston rings in ring grooves in pistons (fig. 22). Clearance between the ring and the ring groove must not be less than .0015 inch or more than .0025 inch. Install ring in cylinder bore and measure ring gap (fig. 21). Used rings which have a gap of more than .020 inch must be replaced. New rings must have .010 to .015 inch gap.

13. Connecting Rods and Bearings.

Check fit of connecting rod bearings on crankshaft journals. Clearance between bearing and crankshaft journal must not exceed .002 inch. Clearance between side of connecting rod and cheek on crankshaft must not exceed .015 inch. Replace rod bearing inserts if worn, cracked, or flaked.

14. Crankshaft.

Crankshaft journals which are out-of-round more than .001 inch or bruised must be reground.

When regrounding, the fillets at the ends of the journals must be maintained. Connecting rod bearings are available .010, .020, and .030 inch under-size for reground crankshafts. All ground and machined surfaces must not be mutilated or excessively worn. Main bearing journal must not be worn sufficiently to prevent ball bearings being a light press fit.

15. Ball Bearings.

Examine bearings for wear or flat spots and replace if damaged.

16. Springs.

Check tension of all springs in accordance with "Specifications" at end of this section and replace any which are weak or broken.

COMPRESSOR REPAIR

UNLOADING VALVE BUSHINGS

If unloading valve bushings require replacement as previously indicated in step 4 under "Inspection," remove bushings by pressing them out through the top of the cylinder head. Press new

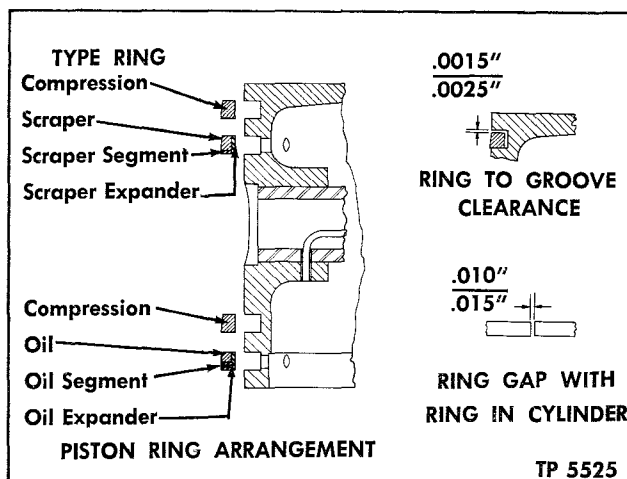


Figure 22—Piston Ring Arrangement and Clearances

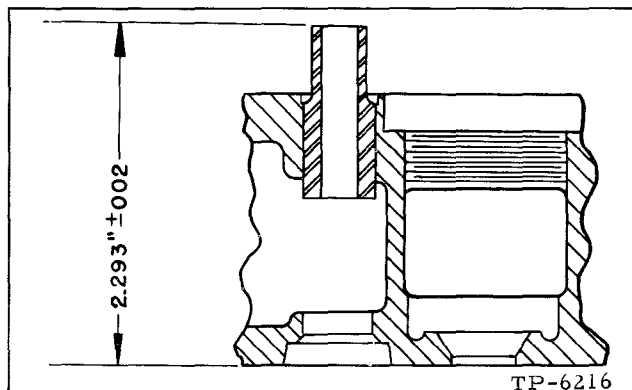


Figure 23—Unloading Valve Bushing Installation

AIR COMPRESSOR AND GOVERNOR**COMPRESSOR ASSEMBLY**

bushings in to height shown in figure 23. After installing bushings, they must be reamed to .2495", + .001" - .000".

UNLOADING VALVES AND SEATS

Unloading valves which are not too badly worn may be ground to their seats using grade 1000 grinding compound, valve grinding tool (BWE-202812), and driver bit (BWE-230197). If the valve seats are badly pitted or worn, they must be reamed using special reamer (BWE-232020). Valves must be ground to their seats after reaming. After grinding, wash valves and seats with cleaning fluid. If valve seats are too badly damaged for reconditioning, cylinder head must be replaced.

DISCHARGE VALVE SEATS

1. If discharge valve seats are only slightly scratched, repair by using grade 1000 grinding compound, lapping disk (BWE-230194), grinding tool (BWE-202812), and driver bit (BWE-230197). If valve seats are pitted, use lapping stone (BWE-221622) before using lapping disc and grinding compound. If seats are badly pitted or scratched, use reamer (BWE-221614) before using lapping stone or lapping disc.

2. Place discharge valves on valve seats, install discharge valve springs in discharge valve cap nuts, and thread cap nuts firmly into cylinder head. To test discharge valves for leakage, connect air line to the discharge port in the cylinder head. Apply 100 pounds air pressure to valves and apply soap suds to discharge valve openings in bottom of head. Leakage in excess of a 1-inch bubble in one second is not permissible. If leakage is excessive, leave the air pressure applied and, using a fiber or hardwood dowel and a light hammer, tap the discharge valves off their seats several times to improve the seal between the valves and seats. Leakage should also be checked by applying soap suds around the top of the discharge valve cap nuts. Leakage at this point must not exceed a 1-inch bubble in five seconds.

3. If discharge valve seats are too badly damaged for reconditioning; cylinder head must be replaced.

CONNECTING ROD BUSHINGS

If piston pin bushings in connecting rods require replacement as previously indicated in step 11 under "Inspection," press old bushings out of connecting rods. Press new bushings into place, making sure that the oil holes in the bushings line up with the oil passages in the connecting rods. Bushings must then be reamed, honed, or bored to provide between .0005 and .001 inch clearance on the piston pin.

CYLINDER BLOCK INSTALLATION

1. Place new cylinder block to crankcase gasket over studs on crankcase. Position cylinder block on crankcase, aligning marks made prior to disassembly. Install nuts and lock washers on studs and tighten firmly.

CRANKSHAFT INSTALLATION

1. Press crankshaft rear bearing onto rear end of crankshaft. Install nut lock and nut on rear end of shaft, tighten nut firmly, then bend lip of nut lock over against flat of nut.

2. Insert forward end of crankshaft through bearing bore in rear end of crankcase and press bearing into crankcase until it is bottomed against shoulder in crankcase.

3. Install seal ring in seal ring groove in boss on forward side of rear end cover. Position new gasket over rear end cover studs. Install rear end cover over studs, making sure the seal ring enters the bore in rear end of crankshaft. Install nuts and lock washers on studs and tighten firmly.

4. Install crankshaft front bearing on front end of crankshaft and press bearing onto shaft and into crankcase until the bearing inner race bottoms against the shoulder on crankshaft.

5. Install key in keyseat in forward end of crankshaft, install drive hub on shaft, and secure with nut and cotter pin.

PISTON AND CONNECTING ROD ASSEMBLY AND INSTALLATION

NOTE: Connecting rods and caps are marked to show the proper relationship between the rod and cap, and to identify their position in the compressor. Marking consists of lines approximately 5/64" long on each cap and rod, located on milled flat on side of each part. No. 1 rod has one line on both rod and cap; No. 2 rod has two lines on rod and cap. No. 1 cylinder is next to pulley end of crankshaft.

Individual connecting rods sold as service parts are not marked. On these, the cap is in correct position when the locking slots in bearing inserts, rod, and cap are all located next to the same connecting rod bolt.

Each rod and the rod bolt nuts are marked with center punch marks to identify their relationship, and to assist in properly tightening nuts. Each nut must be installed on side of rod having same marking (one or two punch marks). Nut is properly tightened when center punch mark is aligned with cotter pin hole in bolt. Do not take the bolt from one side of a rod and install it in

AIR COMPRESSOR AND GOVERNOR

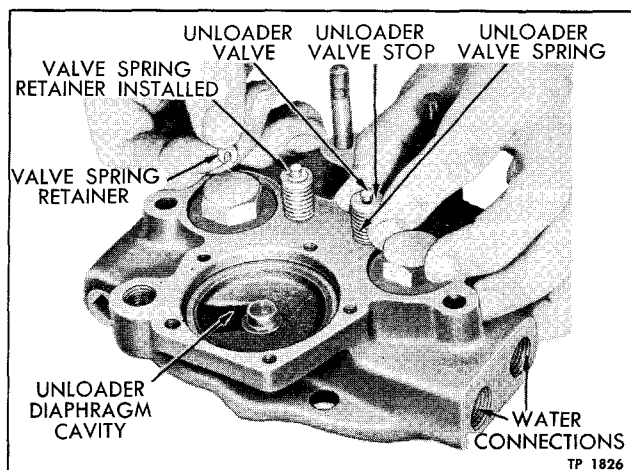


Figure 24—Installing Unloading Valves

the other side, as this will destroy the value of the punch marks on the nuts.

1. Position connecting rod in piston and press piston pin into piston, making sure the piston pin lock hole lines up with the lock hole in the piston. Install new piston pin lock, making sure the lock engages holes in piston pin and piston.

2. Install piston rings in grooves in pistons. Four rings are used on each piston. Compression rings must be installed with silver mark on edge of ring up. Rings must be installed in their proper location and position as shown in figure 22. Note that segment rings and expander rings are used in conjunction with oil ring and scraper ring.

3. Press bearing inserts into rod and cap by hand, making sure locking slots are aligned.

4. Lubricate pistons, rings, piston pin bushings, and bearing inserts with clean engine oil.

5. Turn crankshaft to position No. 1 bearing journal downward. Remove bearing cap from No. 1 connecting rod, leaving bolts in rod.

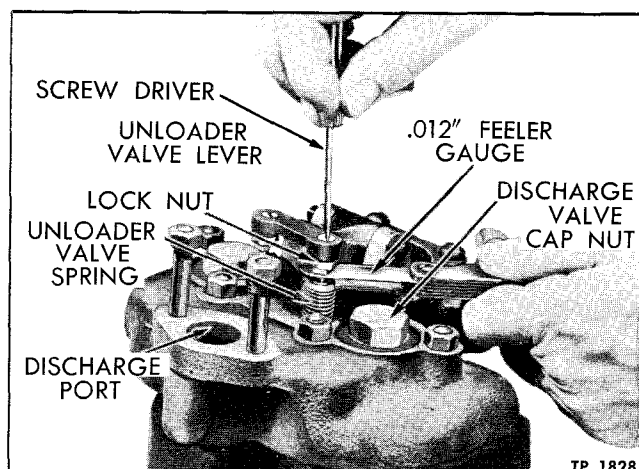


Figure 25—Adjusting Unloading Valves

6. Insert No. 1 connecting rod and piston through top of No. 1 cylinder, being sure the connecting rod bearing engages the crankshaft journal properly. Install bearing cap and nuts, referring to note at beginning of this procedure. After nuts are properly installed and tightened, install new cotter pins.

7. Install No. 2 piston and connecting rod in same manner as described above.

8. Position crankcase bottom cover and new gasket on crankcase and attach with six cap screws and lock washers.

CYLINDER HEAD ASSEMBLY AND INSTALLATION

1. Insert each unloading valve into cylinder head body from bottom side. Place a small wooden block or a nut under each valve to hold it up against seat as head is set on bench. Install unloading valve spring over each valve, then place stop on top of each spring. Compress each unloading valve spring by hand and install spring retainer on valve stem above stop (fig. 24).

2. Place each discharge valve on its seat through opening in top of cylinder head. Place discharge valve springs in discharge valve cap nuts, then thread cap nuts into cylinder head. Tighten nuts firmly.

3. Lubricate unloading diaphragms with a thin coating of light engine oil and place diaphragms in cavity in top of cylinder head. Place diaphragm follower in position on diaphragms with post upward. Install diaphragm cover over diaphragm follower post and attach cover to cylinder head with screws and lock washers. Tighten screws.

4. Check for leakage past unloading diaphragms by applying 100 pounds air pressure to the unloading diaphragm cavity port and apply soap suds all over the diaphragm cover, particularly around the diaphragm follower post. Leakage in excess of a 1-inch bubble in three seconds necessitates disassembly and correction of leakage.

5. Place dust guard in position over end of diaphragm follower post.

6. Install adjusting screws in unloading valve lever with the screw heads and nuts on the under side of the lever.

7. Place unloading valve lever spring in recess in diaphragm cover and position lever over spring. Insert lever pin through diaphragm cover and lever and install a cotter pin in each end of pin.

8. Install drain plug in bottom of cylinder head if it has been removed.

9. Install a new cylinder head gasket over studs so the cut-outs in the gasket will register with the unloading valves when the cylinder head is installed. Install cylinder head on cylinder block so the air discharge port will be on the

AIR COMPRESSOR AND GOVERNOR

right-hand side when compressor is viewed from drive end. Install cylinder head stud nuts and tighten firmly.

10. Install air inlet elbow on side of cylinder block, using new gasket.

11. Adjust unloading valves as directed below.

COMPRESSOR UNLOADER VALVE CLEARANCE ADJUSTMENT

Loosen lock nuts on adjusting screws in unloader lever and turn adjusting screws as shown in figure 25 until clearance between heads of screws and end of unloader valve stems is .010" - .015". This adjustment is important, since too much clearance will not permit the valves to open sufficiently to unload the compressor, while no clearance may hold the valves open and the compressor will not compress air. This adjustment must be made with compressor in cut-in (compressing) position. Tighten lock nuts on adjusting screws after adjustment is completed.

COMPRESSOR TESTS

After overhauling air compressors, it is recommended that they be subjected to the following tests to determine if they are operating properly.

Connect and oil supply line having at least 15 pounds pressure to compressor rear end cover opening. Plug oil inlet passage in bottom of crankcase during test. Provisions must be made for drainage of oil from crankcase during test. Water must be circulated through the compressor cylinder head while the compressor is operating.

RUN-IN TEST

With compressor connected to a suitable source of power to run compressor at 1250 rpm, run compressor for one-half hour with discharge port open to atmosphere. Closely check compressor during this test for oil leaks, overheated bearings, and excessive noise.

OIL PASSING TEST

An oil passing test is made by running compressor for one-half hour at 1250 rpm, pumping against 50 pounds air pressure, with an oil trap connected in discharge line. Oil passed during this test must not exceed 2 cubic centimeters.

EFFICIENCY TEST

Efficiency test is made by running compressor for one-half hour with exhaust port connected to an air tank. With a 1/16-inch diameter relief hole in air line open continuously, the compressor should maintain a pressure of at least 47 pounds.

AIR COMPRESSOR GOVERNOR

Governor, operating in conjunction with compressor unloading mechanism, automatically limits system pressure to a predetermined range by opening unloader valves and stopping compression when pressure has been built up to maximum limit, or by closing valves and starting compression when system pressure has dropped to minimum limit. Governor is connected in air lines as shown in Air Line Diagram at beginning of this group.

GOVERNOR OPERATION (Fig. 26)

1. When air pressure in system is less than maximum for which governor is set, tube (1) holds lower valve (12) against bottom seat. In this position upper valve (13) is open, thus leaving unloader line (8) open to atmosphere through exhaust port (6).

2. When air pressure in system exceeds maximum for which governor is set, tube (1) pulls valve (13) up off valve (12) and, with aid of spring (11) and air pressure under lower valve (12), closes valve (13) against upper seat and opens lower valve. In this position exhaust port (6) is closed and air travels past valve (12) into un-

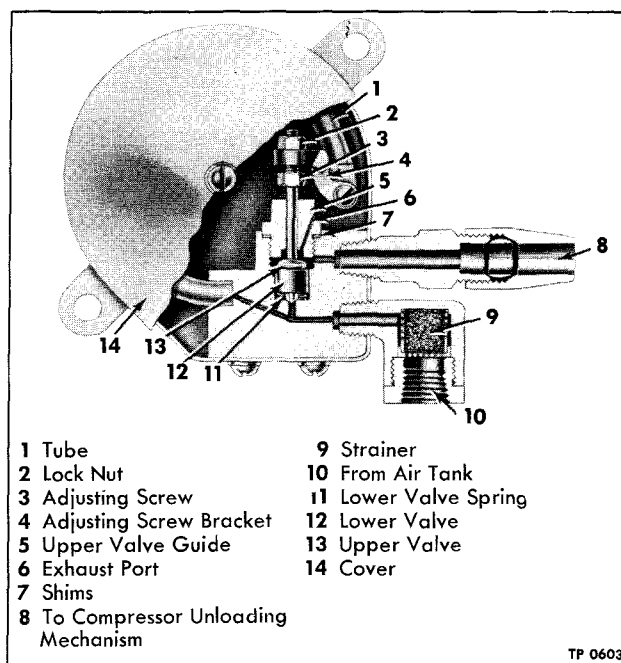


Figure 26—Air Compressor Governor

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AIR COMPRESSOR AND GOVERNOR

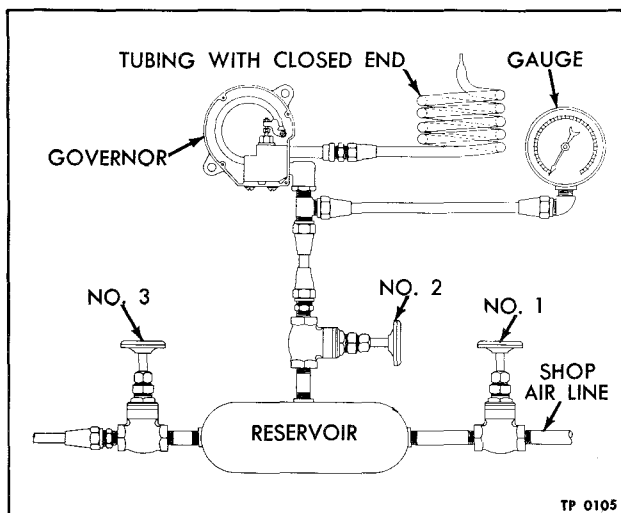


Figure 27—Governor Test Hook-up

loader valve diaphragm cavity, opening unloader valves.

GOVERNOR ADJUSTMENT (Fig. 26)

1. Pressure range (that is the difference between the pressure at which governor causes compressor unloader valves to open or close) may be adjusted by adding or removing shims (7) under valve stem guide (5). Removing shims will increase range; adding shims will decrease range. Changing shims at this point changes the pressure range but does not affect the "Set" or maximum pressure.

2. Set pressure (that is pressure at which governor will cause compressor unloader valves to open) may be adjusted as follows:

- Hold adjusting screw (3) with wrench and loosen adjusting screw lock nut (2).
- To increase set pressure, turn screw (3) clockwise; to lower set pressure, turn screw counterclockwise.
- Hold adjusting screw (3) with wrench and tighten adjusting screw lock nut (2).
- Recheck pressure at which governor cuts in and out in accordance with "Specifications" at end of this section.

GOVERNOR TEST (Figs. 26 and 27)

Governor should be inspected and tested at regular intervals. Leakage and pressure tests described here will give an accurate check as to governor's condition. If governor does not meet all requirements, it should be cleaned, adjusted, repaired, or replaced with a reconditioned unit.

The governor may be tested either on the bench or in the vehicle. The hook-up for testing on bench is shown in figure 27 and the procedure is as follows:

1. Connect governor as shown in figure 27 with all air cocks closed. Remove cover from governor.

2. Open air cock (1), charging reservoir to full line pressure.

3. Crack air cock (2) and note pressure on gauge when governor cuts out.

4. While governor is in cut-out position, apply soap suds to exhaust port (6). If leakage is sufficient to cause more than a 3-inch diameter bubble in three seconds, upper valve should be resealed.

5. Close air cock (1) and crack cock (3), releasing pressure slowly. Note pressure at which governor cuts in and close cock (3) immediately to retain pressure on governor in cut-in position. Apply soap suds to test lower valve leakage.

The governor may be tested in the vehicle by following a procedure similar to that used for bench testing. First build up pressure to cause governor to cut out and observe pressure. Apply soap suds to exhaust port to check upper valve leakage. Second, reduce pressure slowly and note pressure at which governor cuts in. Apply soap suds to check lower valve leakage.

GOVERNOR DISASSEMBLY (Fig. 26)

1. Remove cover (14) from governor case by removing screw from center of cover.

2. Remove tubing connector and air strainer from governor body. Remove four screws and lock washers located at bottom of case and remove governor from case.

3. Remove screw attaching adjusting screw bracket (4) to end of tube (1) and remove adjusting screw (3) and bracket (4). Remove screw from bracket by removing lock nut (2), then unscrewing adjusting screw from bracket.

4. Unscrew upper valve guide (5) from governor body and remove guide and upper valve (13). Remove upper valve (13) from guide (5).

5. Lift shims (7) out of governor body, then invert body and shake out lower valve (12) and spring (11).

6. Disassemble air strainer (9) by unscrewing cap nut from air strainer body and removing cup screen, lamb's wool, and cylindrical screen from strainer body.

CLEANING AND INSPECTION

1. Clean all parts in a suitable cleaning fluid. Be particularly sure that all passages through the governor body are clean and not obstructed in any way. Also make sure small drilled passage in lower valve is clean and open. Lamb's wool in air strainer may be used again if it can be washed clean in cleaning fluid, otherwise it must be replaced.

2. Carefully examine tube for cracks, dents,

AIR COMPRESSOR AND GOVERNOR

or other damage. If damaged in any way, or if it has become loose at the soldered joint at the governor body, the body and tube assembly must be replaced.

3. Inspect seat on upper valve and upper valve guide for wear or damage. Also check fit of upper valve stem in upper valve guide. If the seat on the upper valve shows a decided groove from wear (fig. 28), or if the upper valve stem is not a neat sliding fit in the upper valve guide, the upper valve and valve guide must be replaced as an assembly.

4. Inspect lower valve for wear or damage. If the valve is grooved excessively (fig. 28), it must be replaced. Check fit of lower valve in governor body. It must be a neat sliding fit. If clearance is excessive, lower valve must be replaced.

GOVERNOR REPAIR

1. If the upper valve and seat are not too badly worn, they may be repaired by carefully grinding the valve to its seat using valve grinding tool (BWE-211398) and grade 1000 grinding compound. To grind valve, temporarily install upper valve in upper valve guide and screw guide into body. Valve must be turned back and forth during the grinding operation using a piece of cord in manner illustrated in figure 29. The cord should be pulled in such a manner as to keep the upper valve contacting the valve seat on the valve guide during the grinding operation. Clean valve

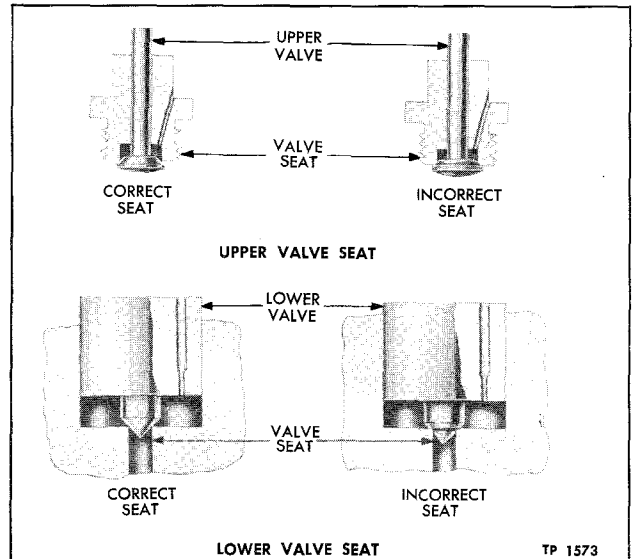


Figure 28—Correct and Incorrect Governor Valve Seats

and seat thoroughly with cleaning fluid after grinding.

2. If lower valve is not worn excessively, it may be ground to its seat using grinding tool (BWE-221609) and grade 1000 grinding compound. To grind valve, insert valve in body, then thread grinding tool into body. Turn valve back and forth using cord in manner illustrated in figure 29. A slight downward pull must be exerted on cord during grinding operation.

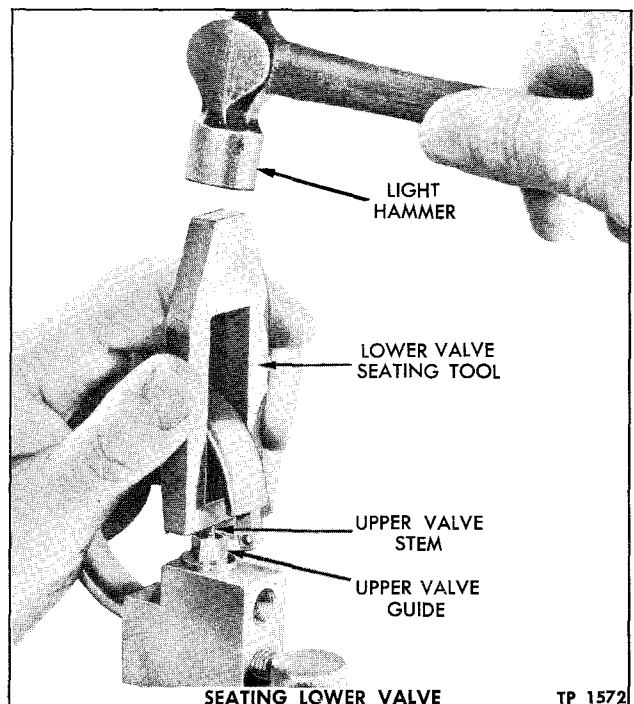
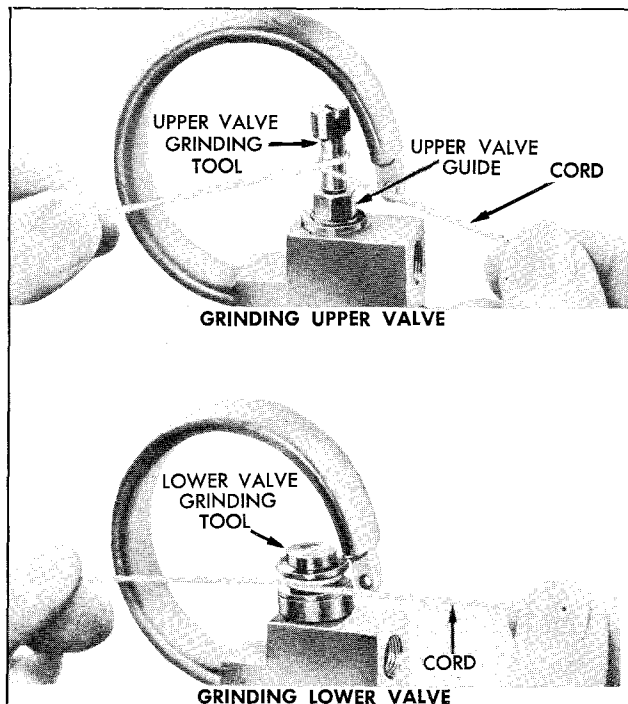


Figure 29—Grinding and Seating Governor Valves

AIR COMPRESSOR AND GOVERNOR

3. If a new lower valve is being installed, tapping the valve to its seat before grinding is usually helpful. To do this, place lower valve in governor body, then install upper valve and upper valve guide in body. Then, using seating tool (BWE-211397) and a light hammer, lightly tap valve to its seat a few times. Grind valve to its seat as directed in step 2 above. Thoroughly clean valve and governor body in cleaning fluid after grinding. If lower valve leakage cannot be corrected by the above procedure, the complete governor must be replaced.

GOVERNOR ASSEMBLY (Fig. 26)

1. Extreme cleanliness of bench, hands, tools, and governor parts is important.

2. Install lower valve spring (11) and lower valve (12) in recess in governor body. Install shims (7) in body, being sure to use same thickness of shims as were removed.

3. Insert upper valve stem (13) through upper valve guide (5) and thread upper valve guide into body. Tighten guide firmly.

4. Install adjusting screw (3) and lock nut (2) in adjusting screw bracket (4) and install bracket on end of tube (1). Tighten screw attaching bracket to tube firmly.

5. Pack cylindrical strainer with new or cleaned lamb's wool and place screen in strainer body. Place cup strainer screen over end of cylindrical screen in strainer body, then install cap nut in strainer body. Thread strainer assembly into lower opening in governor body.

6. Adjust governor as previously directed under "Adjustment," and test as previously directed under "Tests" in this section.

7. If governor passes all tests, remove strainer and install governor assembly in case. Attach with four screws and lock washers. Install cover on case and attach with screw and lock washer.

8. Thread air strainer into lower opening in governor body and tube connection into upper opening. Tighten firmly, with air strainer positioned as shown in figure 26. Plug both openings against entrance of dirt during installation.

Hand Brake

Hand brake is two-shoe, external contracting type, mounted at output shaft on transmission. Brake shoes act on outside of brake drum, which is bolted to transmission output shaft companion flange. Brake shoes are actuated through rods and levers by hand brake lever, located at left of driver.

One-piece block type lining is bolted to each shoe. Bolt holes in lining are counterbored to permit maximum amount of wear on linings before bolt heads are in danger of scoring brake drum.

Lower ends of shoes are mounted on an eccentric anchor pin which provides a means of equalizing lining to drum clearance at lower ends of both shoes. Anchor pin is held in position in anchor bracket by two clamp bolts. Anchor pin is drilled and threaded for lubrication fitting. Anchor pin ends of brake shoes are equipped with replaceable bushings.

Upper ends of brake shoes are held in place by the adjusting screw which is inserted through both shoes and the locating bracket. Adjusting nuts and springs on adjusting screw provide independent adjustment for upper end of each shoe. Lever pin holes in brake shoe are equipped with replaceable bushings.

HAND BRAKE ADJUSTMENT

INITIAL ADJUSTMENT (Fig. 30)

This adjustment is necessary when brake shoes have been relined or replaced, or when anchor pin has been moved from its original setting.

1. Remove two screws attaching brake shield to locating bracket and remove shield.
2. Place hand brake lever in fully released position.
3. Remove cotter pins and loosen nuts on clamp bolts in anchor bracket.
4. Turn anchor pin as necessary to equalize clearance between brake drum and lower end of lining on each shoe. Tighten clamp bolts in anchor bracket and secure with new cotter pins.
5. Adjust upper end of lining to drum clearance as directed later under "Adjustment for Wear."

ADJUSTMENT FOR WEAR (Fig. 30)

This adjustment is to compensate for normal wear. Need of adjustment is indicated when the hand brake lever reserve travel is less than one-half the ratchet range.

Before making this adjustment, check for equal clearance between brake drum and lower end of

lining on each shoe. If clearance is not the same for both shoes, make "Initial Adjustment" previously described.

1. Remove two screws attaching brake shield to locating bracket and remove shield.
2. Place hand brake lever in fully released position.
3. Loosen inner adjusting nut check nut.
4. Turn inner and outer adjusting nuts as necessary to obtain .030" to .040" clearance between upper end of each lining and brake drum.
5. Tighten inner adjusting nut check nut and make sure outer adjusting nut is held in place by lock spring when adjustment is completed.
6. Position brake shield on top of brake shoes and attach to locating bracket with two screws.

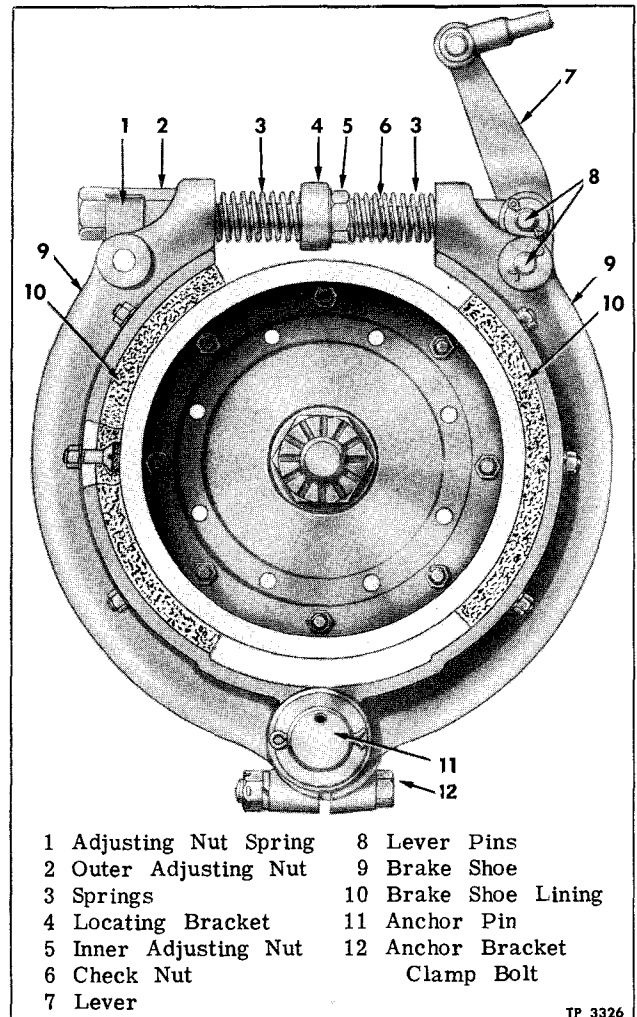


Figure 30—Hand Brake Shoes Installed

HAND BRAKE

BRAKE SHOE REMOVAL

1. Disconnect brake rod from brake shoe lever. Remove two screws attaching brake shield to locating bracket and remove shield.

2. Remove cotter pins from brake shoe lever pins and remove pins from lever and shoe. Remove lever.

3. Remove outer adjusting nut, swing brake shoe out off adjusting screw, and remove outer spring from screw. Remove nuts and lock washers from three locating bracket studs and remove locating bracket. Remove inner adjusting nut, check nut, and inner spring from adjusting screw, then remove adjusting screw from brake shoe.

4. Remove nuts from studs attaching anchor pin bracket to bottom of transmission case; lower brake shoes, anchor pin, and bracket as an assembly from transmission and brake drum. Remove cotter pin and washer from end of anchor pin and slide brake shoes off pin.

5. If necessary to remove brake drum, transmission must be removed. Refer to TRANSMISSION (Sec. 17).

INSPECTION

1. Inspect brake lining and replace if worn down close to bolt heads. Make sure new lining fits firmly against shoe.

2. Examine anchor pin bushings in lower ends of shoes and examine brake shoe pin bushings in upper end for wear. Replace bushings if worn

excessively. Burnish bushings after installation to dimensions listed in "Specifications" at end of this section.

3. Check anchor pin for wear and replace if necessary. Make sure lubricant passages in anchor pin are not clogged.

BRAKE SHOE INSTALLATION

1. Install anchor pin in anchor pin bracket, then position lower ends of brake shoes on anchor pin. Attach brake shoes on anchor pin with washer and cotter pin. Raise the assembly into position, guiding brake shoes up around brake drum. Attach anchor pin bracket to transmission with three stud nuts and lock washers.

2. Insert adjusting screw through upper end of inner shoe. Place inner spring, check nut, inner adjusting nut, and locating bracket on adjusting screw. Attach locating bracket to transmission with three stud nuts and lock washers.

3. Install brake shoe lever, attaching lever to adjusting screw and brake shoe with lever pins and cotter pins.

4. Place outer spring on adjusting screw, then swing outer shoe into position over adjusting screw and install outer adjusting nut. Connect brake rod to brake shoe lever.

5. Lubricate anchor pin as directed in LUBRICATION (SEC. 13). Lubricate brake shoe pins with oil can. Adjust brake shoes as previously directed under "Hand Brake Adjustment" in this section.

BRAKE SPECIFICATIONS

BRAKE SPECIFICATIONS

AIR BRAKES

BRAKE DRUM	FRONT	REAR
Diameter	14.490" - 14.510"	14.490" - 14.510"
Maximum Allowable Out-of-round	0.010"	0.010"
Regrinding Limits (beyond original diameter)	0.125"	0.125"
BRAKE LINING		
Length - each piece (2 pieces per shoe)...	7.33"	7.33"
Width	4"	4"
Thickness	3/4"	3/4"
Area Per Wheel	117 sq. in.	234.5 sq. in.
BRAKE SHOE RETURN SPRING		
Free Length	8-3/8"	9-1/8"
Length @ - lbs. pull	9" @ 50-60 lbs.	9-3/4" @ 85-95 lbs.
CAMSHAFT		
Diameter at Bearing	1.495" - 1.493"	1.495" - 1.493"
Diameter at Spider (rear only)	- - - - -	1.368" - 1.370"
Spider Bushing I.D.	- - - - -	1.374" - 1.376"
CAM ROLLER IN SHOE		
Standard Roller Diameter	1.248" - 1.252"	1.248" - 1.252"
Oversize Roller Diameter	1.748" - 1.752"	1.748" - 1.752"
Roller Side Clearance (Approx.)	0.033"	0.033"
Roller Pin Diameter	0.748" - 0.749"	0.748" - 0.749"
Diameter of Hole in Roller	0.754" - 0.756"	0.754" - 0.756"
ANCHOR PINS AND BUSHINGS		
Pin Diameter at Bushings	1.248" - 1.250"	1.2475" - 1.249"
Pin Length	4-3/8"	7-9/32"
Bushing Diameter		
Inside	1.254" - 1.256"	1.254" - 1.256"
Outside	Tight in Shoe	Tight in Shoe
Bushing Length	1-15/16"	1-15/16"
Diameter of Hole in Shoe	1.373" - 1.375"	1.373" - 1.375"
BRAKE CHAMBERS		
Diameter	8-1/16"	9-7/8"
Type (Stamped on Unit)	C	G
Spring Force at 3/4" Stroke	29-1/2 ± 3 lbs.	55 ± 6 lbs.
Minimum Stroke when Brakes are Adjusted ..	Short as possible without brakes dragging	
Adjust When Stroke Reaches (Max.)	1-3/4"	1-3/4"
SLACK ADJUSTERS		
Type	15-2	15-2
Lever Bushing I.D.	0.501" - 0.503"	0.501" - 0.503"
Length Between Hole Centers	6"	6"

Clutch

CLUTCH

Clutch (fig. 2) is single plate dry disc type, manually controlled (disengaged and engaged) by foot-operated pedal and linkage (fig. 1).

Clutch disc assembly (driven member) is splined to transmission main drive gear. Two facings are riveted to driven disc and these facings are held tightly between friction surface on pressure plate and flywheel plate when clutch is engaged.

CLUTCH CONTROLS

(Fig. 1)

Clutch pedal lever hinges on hand brake cross shaft at rearward end. Clutch control cross shaft is supported in bushings held in place by brackets. Cross shaft has a lever installed at each end. A short link connects cross shaft outer lever to clutch pedal lever. Lever at inner end of cross shaft is connected to forward end of clutch control rod assembly which runs to rear of coach. Pedal return spring is attached between clevis at forward end of clutch control rod and a spring clip attached at bulkhead. Clutch control rod is enclosed in a loom held in brackets beneath coach floor. Rods and loom are protected by covers.

Rearward end of control rod is connected to a bell crank on rearward side of engine compartment bulkhead. Bell cranks and linkage transmit control rod movement to clutch operating lever at clutch housing.

OPERATION

(Key Number in Text Refer to Figure 2)

When clutch is in engaged position, springs (27) exert force against pressure plate (3) clamping driven disc assembly (41) against flywheel clutch plate (42). Crankshaft (38) is thus connected to transmission by driven disc assembly (41) and transmission main drive gear (16).

When clutch is disengaged, release yoke (21) operated by pedal, moves release sleeve (22) which forces release bearing (15) against inner

ends of levers (13). Resultant force at outer ends of levers (13), which are pivoted on pins (6 and 7) in the pressure plate and adjusting yoke, overcomes the force exerted by clutch springs (17) and retracts pressure plate (3), thus releasing clutch.

CLUTCH ADJUSTMENTS

Three adjustments are provided at clutch assembly and control linkage. The only adjustment normally required, however, is that necessary to maintain proper clutch pedal free-travel. The two other adjustments, one to control pedal lever to floor clearance, and the other for setting clutch lever position are required only when replacing parts of clutch or pedal linkage and are covered in the procedures for assembling the respective parts.

Pedal Free-Travel Adjustment (Fig. 1)

Need for pedal free-travel adjustment (defined as first easy movement of clutch pedal) is indicated when inspection shows free-travel movement to be less than 1-1/2 inch.

Operating vehicle without sufficient clutch pedal free-travel will result in excessive wear at release bearing and also will cause clutch slippage.

The gradual reduction in amount of pedal free-travel is a normal condition caused by wearing of driven member facings. Nut (hand wheel) in engine compartment provides a means of adjustment. Adjust as follows:

1. Turn adjusting nut (hand wheel) sufficiently to lengthen bell crank to lever distance to provide the 1-1/2 inches free-travel.

NOTE: Check pedal free-travel with hand on pedal rather than with foot as the adjustment is sensitive.

2. Be sure that return spring at lever in engine compartment is in good condition as spring holds lever against nut to lock adjustment.

3. Make periodical inspection of clutch mechanism through inspection hole in bottom of clutch housing. When clutch levers near the edge of inner rim of cover the clutch disc facings should be replaced.

CLUTCH REPLACEMENT

CLUTCH REMOVAL

(Key Numbers in Text Refer to Figure 2)

Before removing clutch, transmission must

be removed as instructed in TRANSMISSION (SEC. 17). Then proceed as follows:

1. Install six special cap screws (3/8"-16 x 1-1/2", threaded 1 inch) through holes in cover

CLUTCH

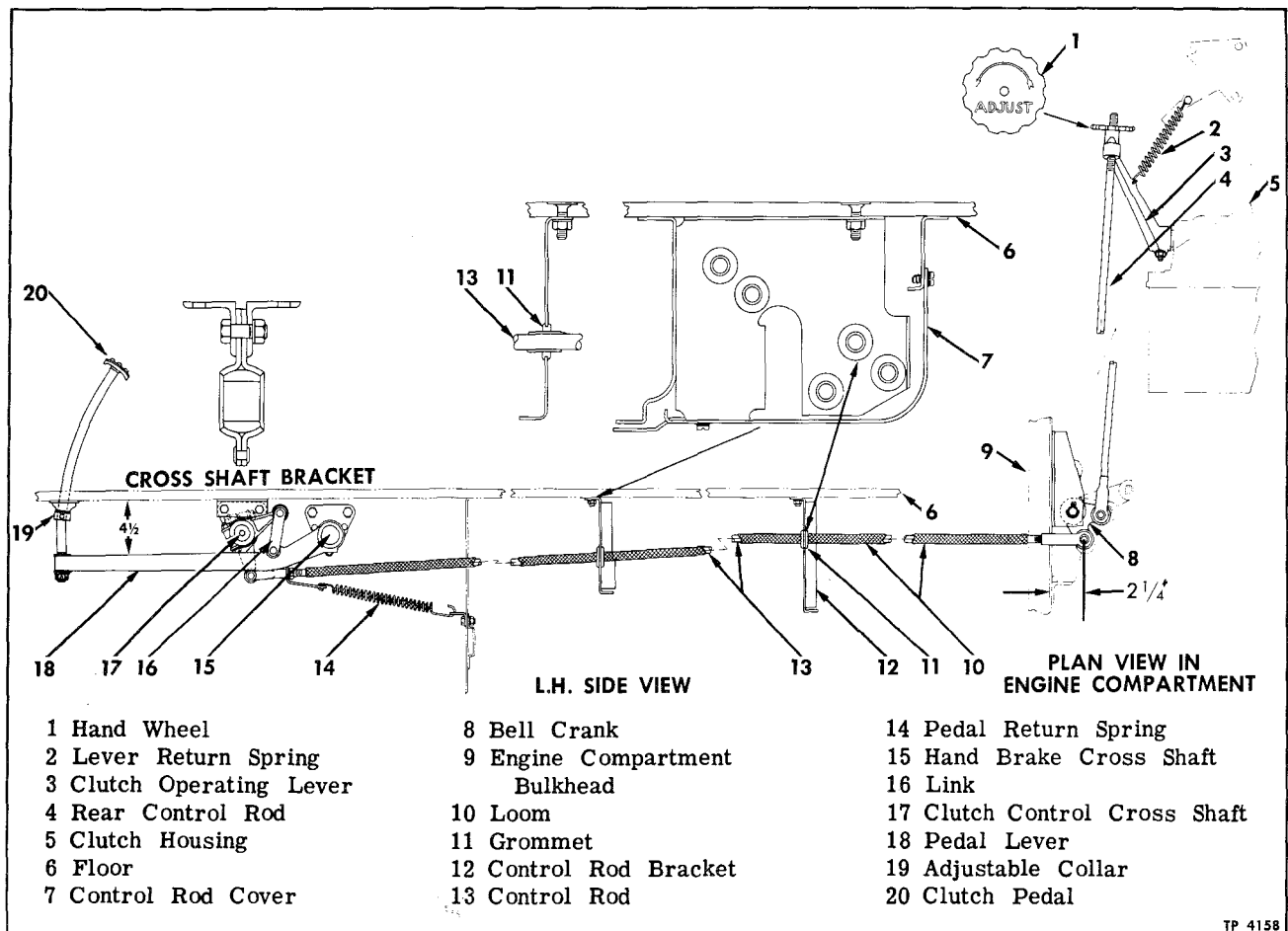


Figure 1—Clutch Control Linkage

plate (25) located directly above each release lever (13). Turn screws into pressure plate (3) as far as possible. This procedure relieves pressure spring (27) load so cap screws (29) can be easily removed.

2. Install aligning arbor (CS-1915-A) or old clutch shaft to support driven disc when removing clutch cover assembly.

3. Remove cover bolts (29) meanwhile supporting clutch to prevent distortion of clutch dowels (8). Tap flange of clutch cover with soft mallet to free assembly from flywheel. Remove clutch assembly and driven disc.

4. Remove bolts (36) and remove retainer (40) which retains pilot bearing (35) in flywheel. After retainer is removed, install two bolts to hold flywheel on crankshaft while removing pilot bearing.

5. Remove pilot bearing using tool (CS-1914, fig. 3). Spread puller prongs in bearing by tightening thumb screw, then slide weight against stop nut to pull bearing.

RELEASE MECHANISM REMOVAL (Fig. 4)

1. Remove hair pin springs connecting release bearing sleeve to release yoke. Disconnect lubrication tube from release bearing sleeve, then slide bearing and sleeve assembly off end of transmission bearing cap.

2. Remove cap screws from release yoke and withdraw clutch shifter shaft from clutch housing.

CLUTCH INSTALLATION

RELEASE MECHANISM INSTALLATION (Fig. 4)

1. Hold clutch release yoke (7) in position in clutch housing (8), then insert shifter shaft (11) through right-hand bushing (9), through yoke (7), and into left-hand bushing.

2. Install clamp bolts (12) and locks which locate yoke (7) on shifter shaft (11).

3. Install clutch release bearing and sleeve assembly (3) on transmission drive gear cap and connect lubrication tube (2). Install springs (4) which clip sleeve to yoke.

CLUTCH

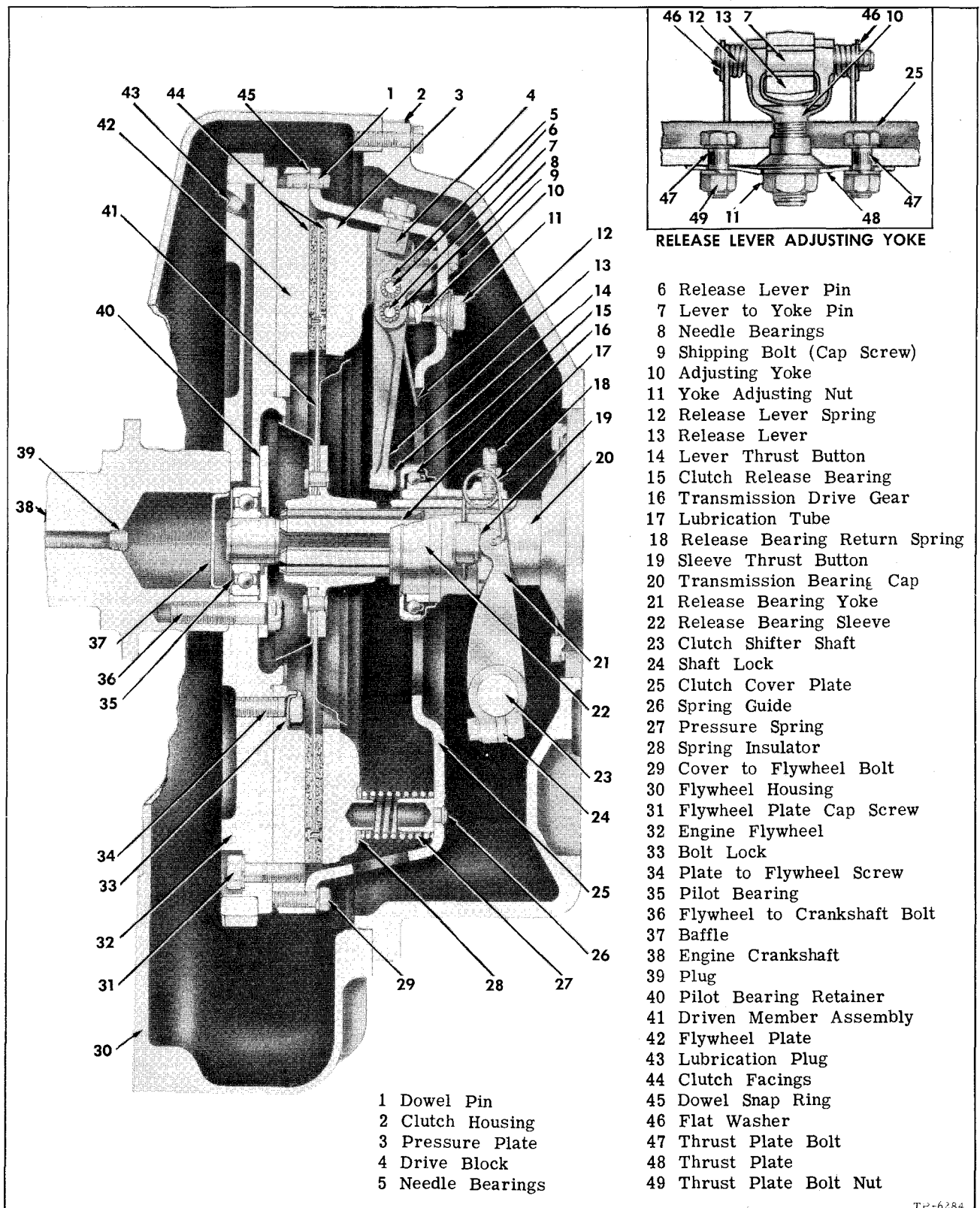


Figure 2—Sectional View of Clutch Assembly

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CLUTCH

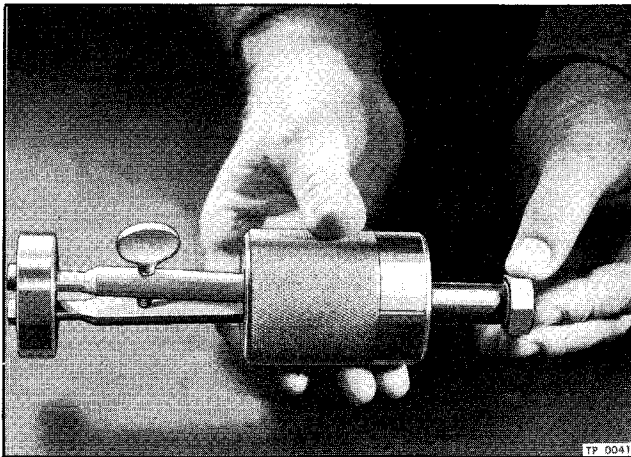


Figure 3—Tool (CS-1914) For Removing Pilot Bearing

4. Install lever (13) on outer end of shifter shaft (11).

5. Check action of shifter shaft to ascertain if binding exists between yoke and release bearing sleeve. If these two parts touch at either side of sleeve, loosen yoke clamp bolts (12) and try driving yoke as necessary to give equal clearance at each side sleeve.

6. Lubricate bushings (9) through fittings and turn down grease cup to force lubricant into release bearing.

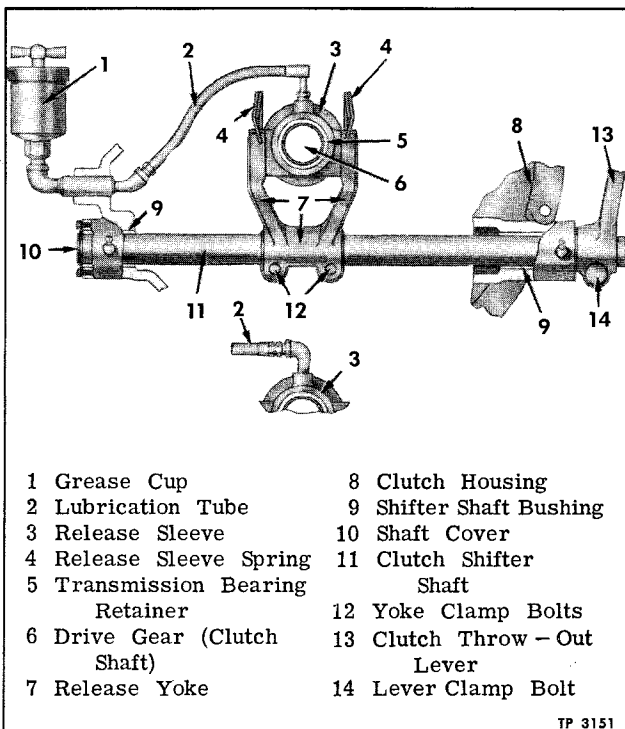


Figure 4—Release Mechanism at Clutch Housing

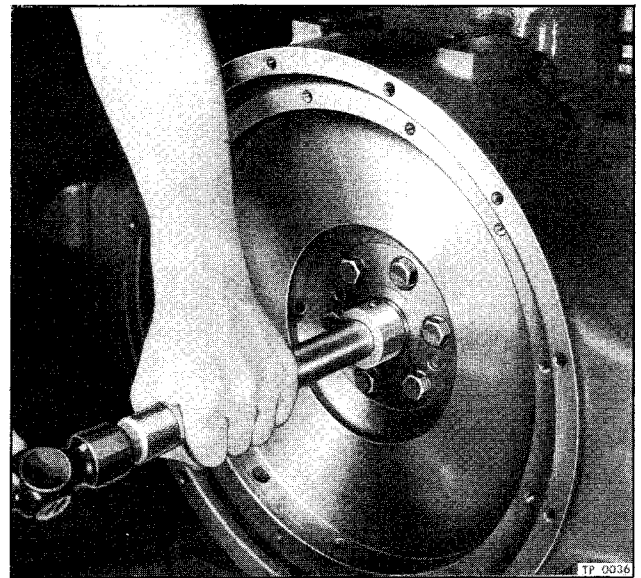


Figure 5—Pilot Bearing Installation

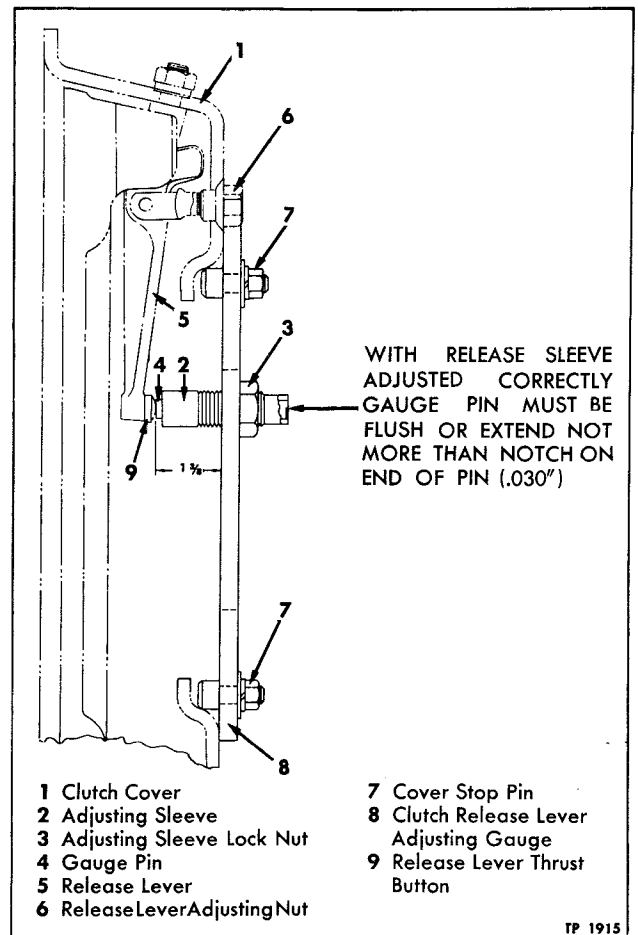


Figure 6—Clutch Release Lever Adjusting Tool

CLUTCH

PILOT BEARING INSTALLATION

1. Hand pack clutch pilot bearing with lubricant specified in LUBRICATION (SEC. 13). If flywheel has been removed from engine be sure grease baffle (37, fig. 2), is in place before installing flywheel and clutch pilot bearing.

2. Using driver to apply pressure at bearing outer race (fig. 5) drive pilot bearing into place in flywheel. Bearing race must bottom against shoulder in flywheel bore.

3. Locate bearing retainer (40, fig. 2) against flywheel and install flywheel to crankshaft bolts. Tighten bolts to 150-160 ft. lbs. using torque wrench. Install lock wire through bolt heads.

COVER PLATE & DRIVEN DISC INSTALLATION

1. Put driven disk (41) in place against flywheel (32) with short end of splined hub toward flywheel. Use aligning arbor (CS-1915-A) or old clutch shaft to hold assembly in position.

2. Place clutch assembly in position against flywheel and install cap screws (29) using new lock washers. Tighten screws securely.

3. Remove special cap screws (fig. 12) previously installed to facilitate clutch installation. These screws must be removed before clutch will engage.

4. Adjust nuts (11) on yokes (10) so that contact points of release lever buttons (14) are within

dimensional limits when measured from straight edge laid across outer face of clutch cover (25).

A closer adjustment may be obtained by using an adjusting tool (CS-1420) such as illustrated in figure 6. "Specifications" at end of this section apply when new driven disc and facings assembly of specified thickness is used.

Use tool in the following manner:

a. With gauge pin flush with outer end of sleeve, thread adjusting sleeve in or out as necessary to obtain the dimension as shown in figure 6. Lock sleeve in position with lock nut.

b. Position tool on clutch cover plate as shown with center of adjusting sleeve in line with center of clutch release lever button; then adjust stop pins until snug against inner edge of clutch cover.

c. Adjust release lever by turning release lever adjusting nut in or out until lever button contacts gauge pin. With lever button just contacting gauge pin, outer end of pin must be flush with sleeve or extend not more than notch (0.030").

NOTE: Setting of release levers in relation to outer face of clutch cover is very important and must be held within limits in order to assure proper clutch action without drag.

5. Install transmission as instructed in TRANSMISSION (SEC. 17) of this manual.

6. Adjust clutch controls as instructed in "Clutch Adjustments" previously in this section.

CLUTCH OVERHAUL

DISASSEMBLY

(Key Numbers in Text Refer to Fig. 2)

1. Remove nuts, washers, and thrust plate (48) used to lock each adjusting nut (11).

2. Remove adjusting nuts (fig. 7) from yokes. Special bolts will hold springs in compressed position while removing adjusting nuts.

3. Mark cover (25) and pressure plate (3) so that relative position will be known when reassembling; then remove six special cap screws (9), turning screws alternately and in gradual stages until spring pressure between cover and plate has been relieved. Lift clutch cover (25) off the pressure plate assembly.

4. Remove springs and insulators (27 and 28) from pressure plate bosses.

5. Remove cotter pins from release lever pins (6 and 7) and pull out pins. Be careful to note position of washers (28), springs (27) and number of rollers (5 and 8) so parts can be reassembled correctly. This completes disassembly of release levers (13), adjusting yokes (10) and pressure plate (3).

INSPECTION

Prior to inspection, wash clutch parts (except driven disc facings) in clean gasoline or cleaning fluid. Refer to "Specifications" at end of this section for all clearances.

1. Inspect driven disc assembly for worn, loose or oil-soaked facings; for loose rivets at hub; for distortion. If disc is distorted, new driven disc and facings assembly should be used. DO NOT RELINE DISTORTED DISC. Refer to "Specifications" at end of this section.

2. To inspect release bearing, first soak in gasoline or cleaning solvent, tap sharply on wood block to dislodge dirt particles, flush in gasoline or cleaning solvent and blow dry by directing air at right angle to bearing, revolving slowly by hand. Examine bearing for pits and scores and, if usable dip in clean oil. Do not disassemble bearings.

3. Inspect pressure plate and flywheel plate for checks and scores on contact surface. For refacing of pressure plate, see "Refacing Clutch Pressure Plate" under "Repair" later in this section. Flywheel plate can be refaced in similar manner.

CLUTCH

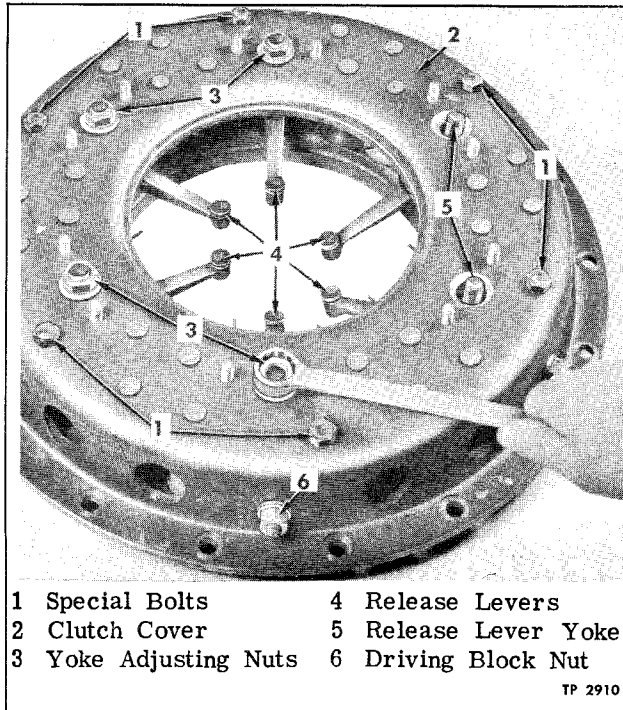


Figure 7—Yoke Adjusting Nut Removal

4. Check clearance between driving blocks and slotted lugs in pressure plate. If there is indication of wear or scoring on driving blocks, replace same.
5. Clean and inspect rollers used at release lever pins. Replace if rollers show wear.

REPAIR

CLUTCH DRIVEN DISC AND FACINGS

In normal service, clutch facings wear evenly and last for a long time.

To replace facing, drill out facing rivets from

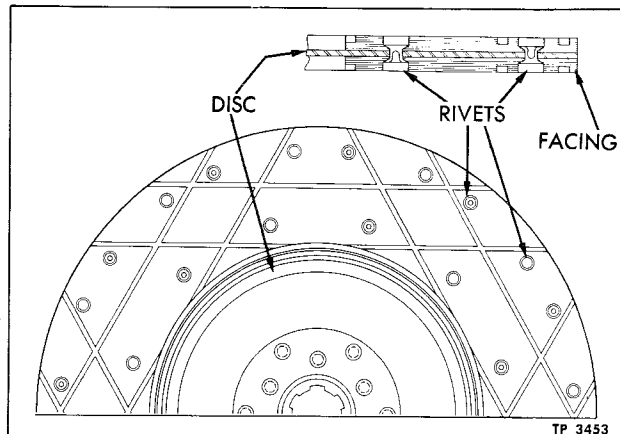


Figure 8—Clutch Disc Facing Rivet Pattern

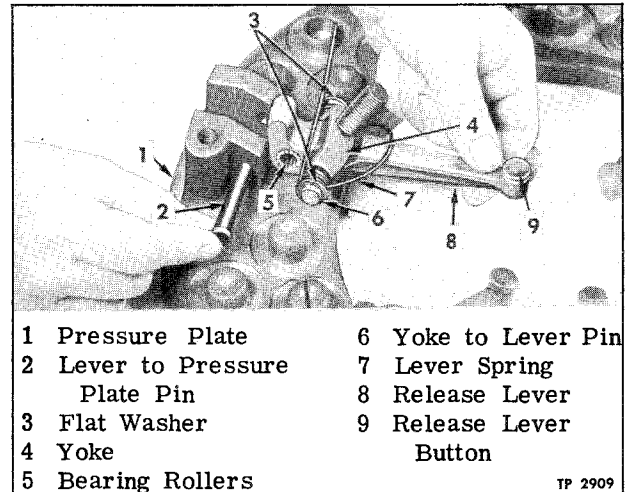


Figure 9—Assembling Clutch Release Lever To Pressure Plate

head of smooth side of rivet. Use drill slightly smaller than rivet diameter. Rivet will turn if drilled from other side.

Support assembly during facing removal and installation to prevent distortion of disc.

DO NOT USE BRAKE RELINING MACHINE TO REMOVE RIVETS AS CLUTCH DISC WILL BE SPRUNG OR DISTORTED.

Facings are interchangeable. When installing new facings, use genuine rivets and facings listed in GMC Parts Book.

Alternate rivets so that heads are in opposite directions as shown in figure 8.

Check over-all thickness of assembly after facings are installed. Test assembly for run-out. Disc should run true within limits given in "Specifications" at end of this section.

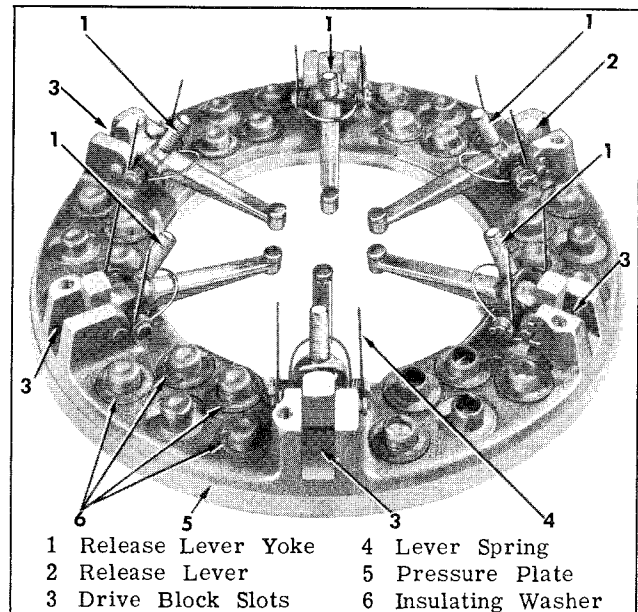


Figure 10—Pressure Plate and Release Levers

CLUTCH

PRESSURE PLATE AND FLYWHEEL CLUTCH PLATE

Either the clutch pressure plate (3) or flywheel clutch plate (42), or both, if scored, or checked, can be refaced to produce a flat smooth surface. Before beginning resurfacing operation, measure thickness of parts. This is necessary to determine if parts have been resurfaced previously. Measure thickness of clutch pressure plate from front face to finished face of pressure spring seat. Be sure insulating washers (6, fig. 10) have been removed.

To refinish flywheel plate, remove the flywheel assembly from engine and perform machining operation with plate bolted to flywheel. Shim washers 1/32" thick are available for use when assembling clutch after resurfacing clutch pressure plate. Therefore, when resurfacing this plate, at least 1/32 inch of stock should be removed at a time. This will permit the use of the 1/32-inch shims and thereby maintain torque capacity of clutch. No shims are required to compensate for metal removed from plate on flywheel. Do not reduce the original thickness of either plate more than 3/32 inch. Original thickness of each part is given in "Specifications" at end of this section.

No more than three 1/32-inch shims should be used under each pressure spring when building up clutch cover and pressure plate assembly.

CLUTCH HOUSING AND DOWEL PINS

Two dowel pins, held in clutch housing with snap rings, locate clutch housing on main transmission case. In production, clutch housing is bolted to main case with drive shaft bearing retainer in place. The dowel pin holes in both case and housing are then line reamed, and dowels installed. A finish cut is then taken on shoulder of clutch housing to align housing concentric with transmission mainshaft.

Service clutch housings are machined in same manner before shipment except that dowel pin holes are left under-sized. Bolt new clutch housing to main case as explained. Line ream dowel holes and install dowels and snap rings. Concentricity and squareness of clutch housing flanges should be within limits listed in "Specifications" at end of this section.

CLUTCH ASSEMBLY

(Key Numbers in Text Refer to Fig. 2)

1. Assemble adjusting yokes (10) and springs on clutch release levers as follows:

a. Make two pilot pins slightly shorter than needle rollers and same diameter as pins (6 and 7). Chamfer ends of pilot pins.

b. Lay lever (13) on flat surface and insert a pilot pin in each hole. Apply light coat of release bearing lubricant on needle rollers referring to LUBRICATION (SEC. 13) for correct lubricant. Insert rollers (5 and 8) around pilot pins, then put adjusting yoke (10) in position with spring (12) straddling yoke. Place flat washer (46) on pin (8) then push pin through spring, yoke, and lever, thereby pushing out pilot pin. Assemble washer (46) and cotter pin to retain pin (8).

c. Position lever and yoke assembly at pressure plate, then install pin (fig. 9) and retain with cotter pin.

d. Repeat procedure described in steps b. and c. above to assemble each lever to pressure plate.

2. Place pressure plate and levers assembly (fig. 10) face downward on bench. If the pressure plate or flywheel plate has been resurfaced, place 1/32 inch shims between insulating washers (28) and spring bosses on pressure plate. Use one shim for each 1/32 inch of material removed during resurfacing operations. Refer to figure 11 for proper position of springs on pressure plate.

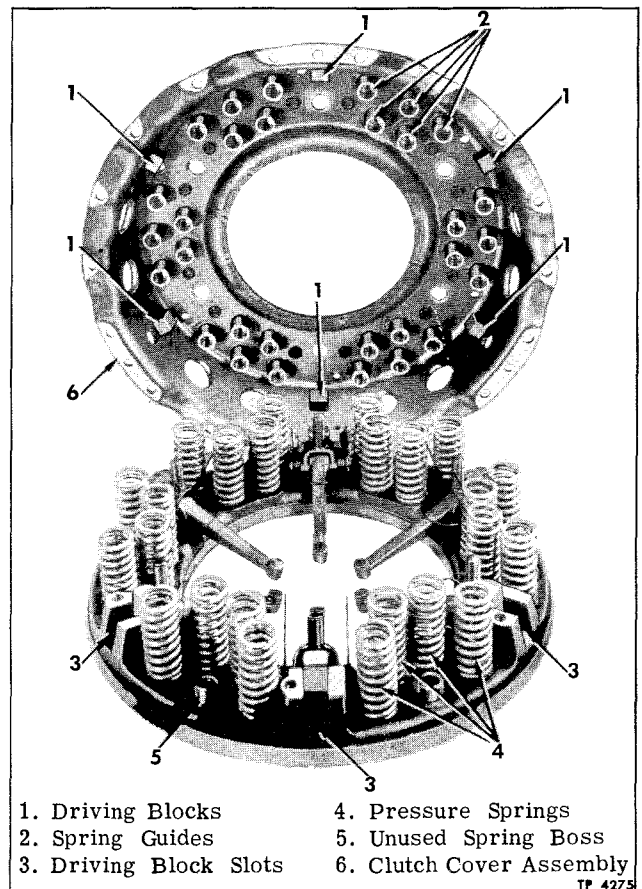


Figure 11—Cover Assembly Removed, Showing Spring Arrangement on Pressure Plate

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CLUTCH

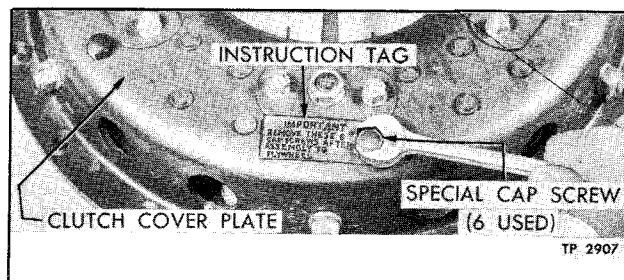


Figure 12—Clutch Instruction Tag and Special Cap Screws

3. When insulating washers (28) and springs (27) are in position, set cover (25) over springs (27), fitting each spring guide (26) on cover into corresponding spring. Cover must assume original position in relation to pressure plate. Refer to alignment marks made at disassembly to determine correct position. Drive blocks (4) must enter slots in pressure plate.

4. Install six special cap screws (fig. 12) through holes in cover plate, starting each screw into tapped hole in pressure plate, then tighten special screws alternately and in gradual stages to compress springs (27) and bring threaded ends of yokes (10) into respective holes in cover plate. A pointed rod may be used to guide yokes through holes as cap screws are tightened. See that ends of springs (12) do not catch on under side of cover as special screws are tightened.

5. Thread adjusting nuts (11) onto yokes (10) so that end of yoke is approximately flush with top of nut.

6. Install adjusting nut thrust plates (48), tightening plate retaining nuts firmly.

7. Clutch assembly is now completely built up and ready to be assembled to flywheel. Special cap screws must remain in place until cover to flywheel screws have all been installed, then they must be removed to allow clutch springs (27) to operate.

CLUTCH CONTROL MAINTENANCE

(Key Numbers Refer to Fig. 1)

In addition to the adjustment for pedal free-travel previously described, the following should

obtain to provide minimum pedal pressure to disengage clutch:

1. Be sure all pivot points in control linkage are lubricated according to instructions given in LUBRICATION (SEC. 13).

2. Check dimension between clutch pedal lever and under side of floor. If necessary to provide the 4-1/2 inch dimension, (fig. 1), move the adjustable collar (19) which is held in place by set screw.

3. Always use return springs (2 and 14) as specified in Parts Book.

4. When replacing control rod (13), rod end clevises, or bell crank (8), adjust rod end clevises so that center of pin hole in bell crank (8) is 2-1/4 inches from bulkhead as shown in figure 1. This will give best leverage for disengaging clutch with light pedal pressure.

CAUTION: Always check pedal free-travel and adjust to 1-1/2 inch after replacing control linkage parts or making other adjustments.

CLUTCH LUBRICATION

Lubrication intervals and recommended lubricants are specified in LUBRICATION (SEC. 13). Lubrication points follow below:

1. Clean release bearing in gasoline as it is not permanently lubricated type. Dip cleaned bearing in oil before reinstalling. Bearing should be lubricated thoroughly at installation and periodically thereafter by large grease cup attached to clutch housing.

2. Pilot bearing should be packed with lubricant at assembly. Additional lubricant should be supplied periodically through hole in flywheel.

Replace plug in flywheel with a standard lubrication fitting. Then reinstall plug in flywheel after lubricant has been added. Plug in flywheel is accessible through hole in flywheel housing. Turn flywheel as necessary to align plug with hole.

3. Clutch shaft splines should be lubricated at assembly.

4. Clutch release mechanism should be lubricated at regular intervals.

5. Clutch shifter shaft bushings should be lubricated periodically through fittings located in bosses in each side of clutch housing.

CLUTCH

SPECIFICATIONS

Type Single Plate Dry Disc

Driven Disc and FacingsFacings

Quantity 2
Outside Diameter 16-3/4"
Inside Diameter 10"
Thickness Each Facing 0.184"-0.190"
Disc and Facings - Total Thickness 0.457"
Driven Disc Run-Out - Taken at 7-1/2" Radius on Flywheel Side
..... Not to Exceed 0.035"

Clutch Pressure Springs

Type Coil Compression
Number Used 24
Free Length 2.843"
Lbs. Pressure @ 1.950" 127-1/2 - 132-1/2

Release Lever Tension Spring

Free Position 45° from Horizontal
Number Used 6

Clutch Pressure Plate

Original Thickness 15/16"
Reface to Not Less Than 27/32"

Flywheel Clutch Plate

Original Thickness 0.870
Reface to Not Less Than 25/32"
Outside Diameter 19-3/8"
Bore 7.5005" - 7.5015"
Dowel Ream 0.3732" - 0.3739"

Clutch Release Bearing and Support

Type Ball

Clutch Pilot Bearing

Type Ball

Clutch Yoke and Shifter Shaft

Clearance - Between Yoke and Release Bearing Support Equal Both Sides
Shifter Shaft Diameter 1.1250" - 1.1235"

Clearance Between

Cover Plate Drive Blocks and Pressure Plate 0.008" - 0.013"
Driven Disc Hub and Transmission Main Shaft Spline 0.005" - 0.003"

Clutch Adjustment

Pedal Free Travel (See Instructions) 1-1/2"
Release Levers to Face of Clutch Cover 1-3/8"
Levers in Same Plane Within 0.030"

Transmission Clutch Housing Pilot Hole

Run-Out Not to Exceed 0.001"

Clutch Housing Pilot Flange Run-Out

Not to Exceed 0.002"

Clutch Housing Squareness

Rear Housing Rear Face Square with Crankshaft within 0.010" total indicator reading checked at 3-5/8" radius.

SERVICE BULLETINS

NOTES

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Cooling System

This group includes sections covering maintenance information on "GENERAL COOLING SYSTEM," "RADIATOR, SHUTTERS, AND THERMOSTAT," and "FAN AND WATER PUMP."

Cooling System—General

Engine is cooled by means of a sealed, pressure-type system. Employing a valve to control pressure, sealed system reduces evaporation and permits higher engine operating temperatures.

Surge tank, mounted as shown in figure 1, permits expansion of coolant without loss, under normal operating conditions.

Economical operation of engine depends largely upon proper operating temperature being maintained. Adequate control of operating temperature during hot or cold weather is assured, provided all units are properly maintained.

Cooling system preventive maintenance should be practiced. Rust and corrosion damage should be eliminated by preventing formation of rust and corrosion, rather than by correction of rust clogged water passages through clean-out methods or replacement of damaged parts after cooling system is in trouble.

CIRCULATION

Coolant from radiator is force-circulated, by water pump, through oil cooler and engine water jacket around cylinder bores. Flowing upward, coolant circulates around exhaust valves and injectors in cylinder head. Coolant then flows through radiator and is cooled by action of fan.

ENGINE WARM-UP

Refer to figure 1. Thermostat, located in engine water outlet manifold, is closed and restricts flow of cooling liquid into radiator until minimum temperature (predetermined by calibration of thermostat) is reached. During this period circulation of cooling liquid is through engine heating system by way of heater supply line (17) and back to oil cooler (12) through return line (14).

Warm water from heating system flowing through oil cooler warms lubricating oil; thus shortening the warm-up period.

When pressure from engine water pump is sufficient to unseat by-pass valve (6, fig. 2), water is forced through by-pass tube (7) to inlet side of water pump.

NORMAL OPERATING TEMPERATURE

As cooling liquid nears normal operating temperature, thermostat opens gradually, permitting circulation through radiator as required to maintain proper operating temperature. As thermostat opens, permitting flow through radiator, pressure against by-pass valve (6, fig. 2) is relieved so that no water circulates through by-pass tube, except from air compressor return line (8, fig. 1).

Under these conditions, the water which is cooled by passing through radiator core flows through oil cooler and lowers temperature of engine lubricating oil.

ENGINE OPERATING TEMPERATURE CONTROL

ENGINE THERMOSTAT (Fig. 2)

Cooling system is designed to provide adequate cooling under the most adverse conditions; however, some device must be used to maintain operating temperature within a definite range and to prevent over-cooling during normal operation. This is accomplished by means of a thermostat (2), in the engine water outlet, to regulate flow of cooling liquid through radiator.

Thermostat consists of a valve actuated by a thermostatic element and return spring. Valve starts to open at a predetermined temperature and continues to open gradually as temperature increases. Refer to "Specifications," at end of this section, for operating temperature. Thermostat is not adjustable, its action being determined by design of element.

Thermostat Maintenance

If action of water temperature gauge, on instrument panel, indicates engine thermostat is not functioning properly, remove thermostat. Note if component parts appear to be in good condition. If so, test action in water bath, as follows:

Use a reliable thermometer to indicate temperature of water, also agitate water thoroughly at all times. Suspend thermostat in water, completely immersed, but not touching bottom of con-

GENERAL COOLING SYSTEM

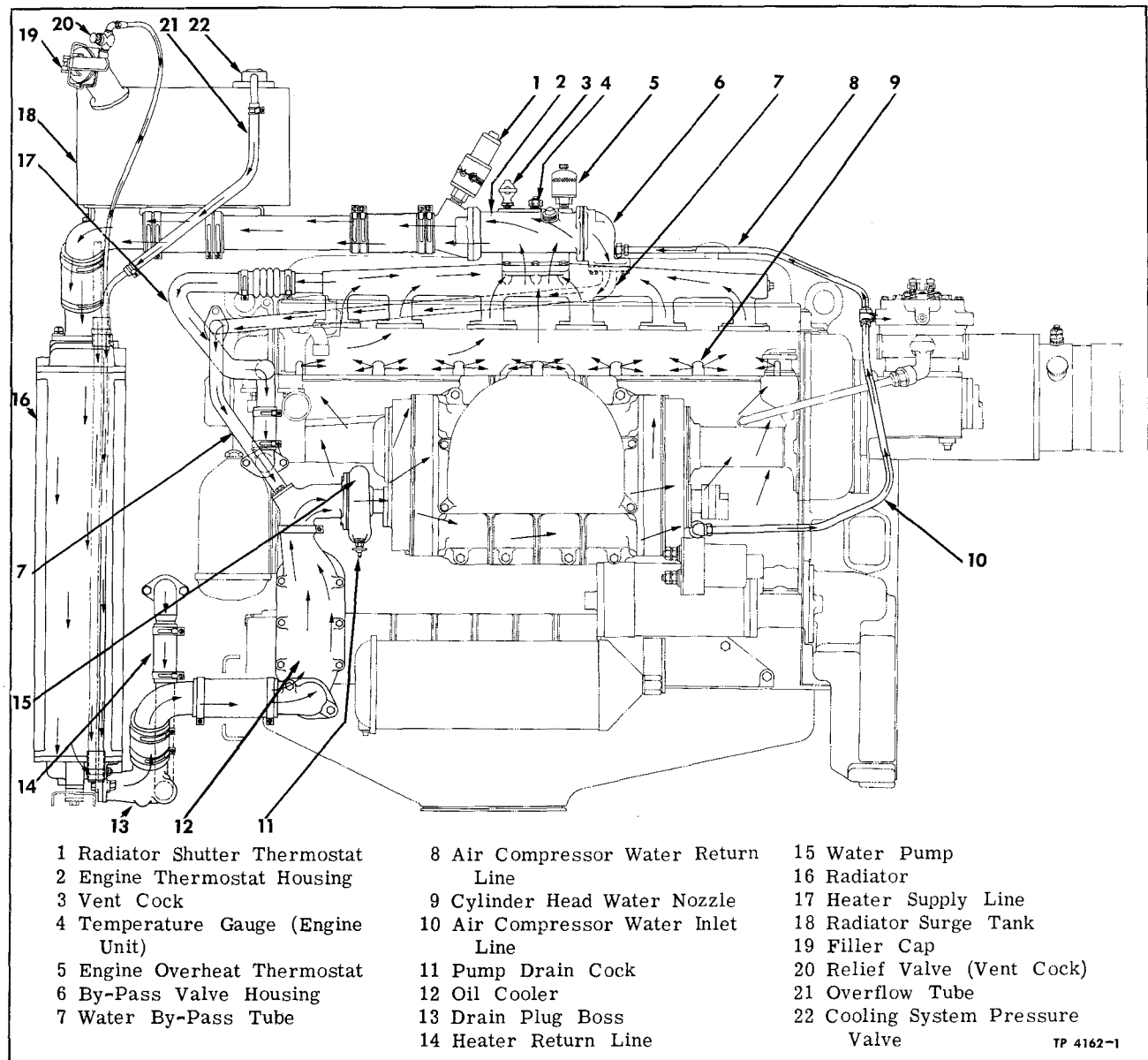


Figure 1—General Arrangement of Cooling System Units

tainer. Gradually heat water to opening temperature of thermostat valve (refer to "Specifications"). Hold temperature of water for two or three minutes, to give thermostat an opportunity to react; then gradually increase temperature of water until fully-opened temperature is reached.

Do not attempt to repair thermostat, other than removal of sludge, rust, or scale. Be sure bleed hole (10) through thermostat valve is not obstructed. If thermostat does not function properly, install a new one which has been checked, as directed above, and known to be functioning correctly. Use new gasket, when installing thermostat.

WATER TEMPERATURE INDICATOR SENDING UNIT

Water temperature indicator system consists of two electrically connected units; a sending unit mounted in engine water outlet (fig. 2) and a registering gauge mounted on instrument panel.

System is interconnected with control switch as shown on Alarm and Signal Wiring Diagram, at end of this manual. Note that system is operative only with engine control switch in "RUN" position.

GENERAL COOLING SYSTEM

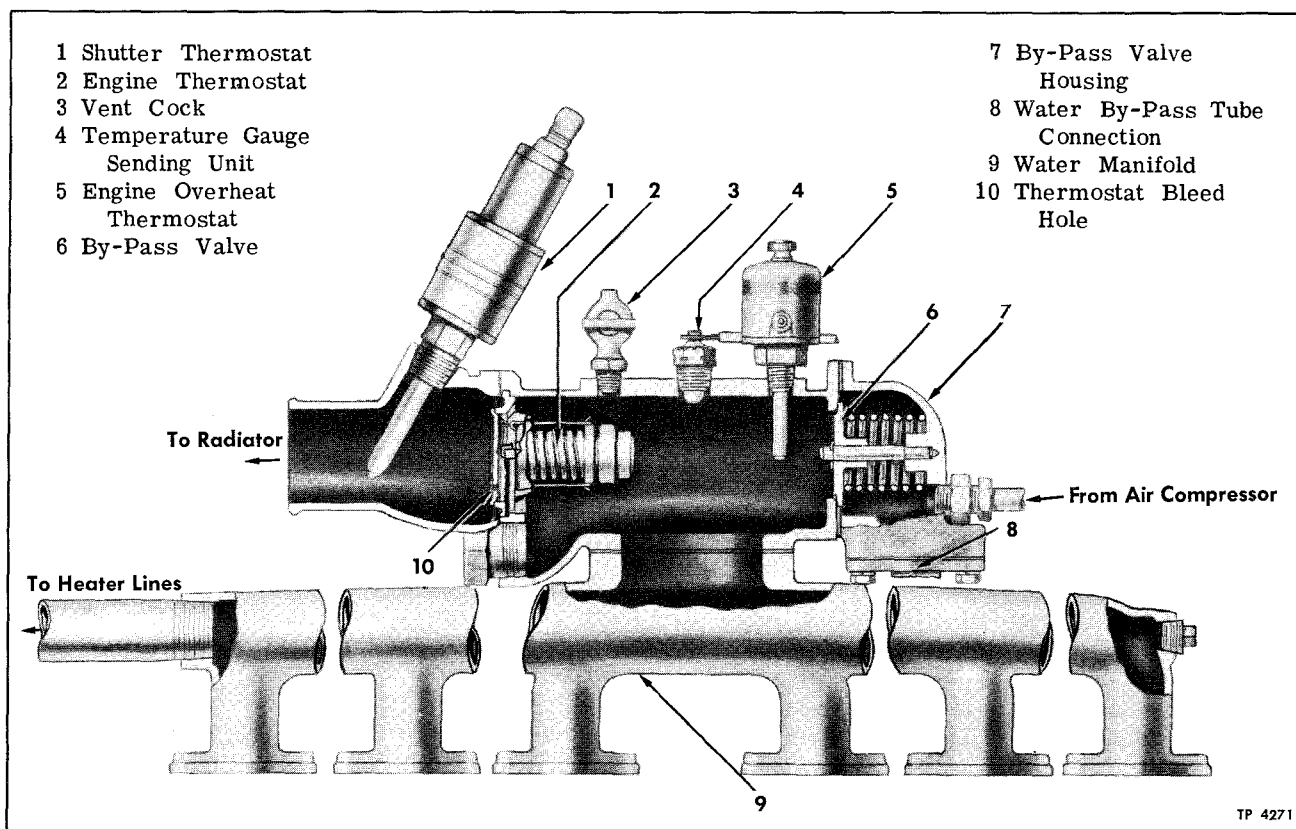


Figure 2—Sectional View of Engine Water Outlet Connection

Tests

To test sending unit, disconnect wire from terminal and proceed as follows:

1. Connect one lead of a 1.5 candlepower, 12-volt test lamp to battery terminal on starter solenoid. Touch other lead to body of engine sending unit. If bulb lights, unit is properly grounded. If bulb does not light, check for presence of sealing compound around threads of unit. Remove compound and repeat test.

2. Remove test lamp lead from body of unit. and touch lead to terminal on unit. If bulb lights engine unit is shorted and should be replaced.

3. Remove test lamp and reconnect wire from gauge unit to engine unit terminal.

4. Do not attempt to repair engine unit. When installing new engine unit do not use thread sealing compound on threads as this will increase electrical resistance of unit and cause faulty reading on gauge.

5. After testing sending unit, if gauge at instrument panel fails to function properly, refer to ELECTRICAL SYSTEM (SEC. 7), for instructions for checking wiring and gauge unit.

WATER OVERHEAT THERMOSTAT

Engine overheat thermostat (5, fig. 2), mounted

as shown, incorporates a thermostatically-controlled switch, connected into vehicle electrical system. Refer to Alarm and Signal Wiring Diagram, at end of this manual, for circuits.

Operation

When engine becomes overheated, thermal element in overheat thermostat causes contact points to close, thereby completing electrical circuit to tell-tale light and alarm buzzer.

When alarm is given, vehicle should be immediately stopped and cause of overheating determined.

MAINTENANCE

At 30,000 mile intervals, thermostat should be removed and tested for actual operation. This can easily be done by inserting tube of thermostat in oil heated to a temperature of 250 to 275 degrees F. If points contact readily, correct working of instrument is indicated. (The 250 to 275 degrees F. temperature for the testing oil is arbitrarily selected, in order to make the check quickly, and bears no relation to temperature at which thermostat is set.)

At 15,000 mile intervals remove thermostat

GENERAL COOLING SYSTEM

cylindrical cover, clean contact points, if necessary, and blow out any dirt inside body.

NOTE: Before testing thermostat be sure that entire unit is pre-heated to approximately engine temperature (170 degrees F.).

At any time excessive engine temperature causes the instrument to act, the thermostat should be removed from the vehicle and checked as above.

COOLING SYSTEM MAINTENANCE

INSPECTION OF SYSTEM

Systematic periodic inspection of units in cooling system is essential to maintain efficiency of system. Inspect at regular intervals as follows:

1. Check coolant in cooling system. Keep system filled to proper level. Check anti-freeze solution, if used.

2. Rust proof cooling system twice a year. Use a good chemically treated antifreeze in fall and a special rust preventive (inhibitor) with a fresh filling of water in the spring.

3. Check condition of all flexible couplings. Tighten or replace if necessary. Cracked, swollen, or deteriorated couplings should be replaced.

4. Check radiator and heater cores for leaks. Make certain that cores are not clogged with dirt or insects. Clean out with compressed air, using low air pressure.

5. Inspect pump operation. A leaky water pump sucks in air, which increases corrosion.

6. Repair all leaks. One drop of solution each ten seconds amounts to nearly one gallon lost in one week.

7. Inspect and tighten radiator mountings.

8. Test and replace thermostat if necessary. Bear in mind that causes of overheating in cooling system are not always traceable to defective operation of cooling units. Refer to Diesel Engine Maintenance Manual (Form X-5014A) for other causes of engine overheating.

LOSS OF SOLUTION

Solutions may be lost from cooling system through leaks, or overheating, which may be caused by:

1. "Hot spots" in rust and lime-clogged engine water jackets, causing steam which forces solution out surge tank overflow.

2. Air suction into system at leaky water pump or from low level in system.

3. Rust-clogged radiator.

4. Thermostat stuck in closed position.

5. Inoperative radiator shutters

FILLING SYSTEM

Only pure soft water, recommended inhibitors, and ethylene glycol antifreeze should be used in the cooling system. Refer to "Corrosion Damage

Prevention," later in this section for additional information.

REPLENISHING SYSTEM

Coaches are equipped with a push-button type pressure relief valve and tube (20, fig. 1); valve is installed in radiator surge tank filler neck, accessible after opening filler cap door.

CAUTION: Avoid injury from hot water or steam by following instructions in sequence given.

1. Press relief valve button and hold depressed until all pressure in system is relieved.

2. As an added precaution, lift surge tank filler cap handle only to first or safety stage, standing clear to prevent burns from existing steam. After making sure all steam has escaped, trip catch and open filler cap.

IMPORTANT: If engine is overheated, do not add cold water immediately. Wait until boiling has stopped and engine has cooled off; then add coolant with engine running.

3. With engine running, add coolant to level of filler cap opening. When closing filler cap, make sure safety catch engages edge of cap.

4. If water level was extremely low, bleed heating system to make sure all air is expelled. Refer to "Heating and Ventilation" in BODY (SEC. 3).

FILLING EMPTY SYSTEM

When system has been completely drained, use following procedures to insure proper filling of system.

1. If heating system was not drained, open gate valves in heater lines; valves are located in battery compartment. If heating system was drained, make sure all drain cocks and vent cocks in heating system are closed. Refer to "Heating and Ventilation" in BODY (SEC. 3).

2. Make sure drain cock at bottom of water pump is closed, and that drain plugs are installed in bottom of radiator outlet connection and in air compressor cylinder head.

3. Open vent cock (3, fig. 2) on top of engine thermostat housing.

4. Add coolant through surge tank filler neck until liquid begins to flow from thermostat housing vent cock, then close vent cock. Continue adding liquid until level with filler cap opening.

5. Start engine and run at a fast idle until normal operating temperature is attained. Bleed air from heating system as directed in "Heating and Ventilation" in BODY (SEC. 3).

6. Reduce engine speed to normal idle.

GENERAL COOLING SYSTEM

CAUTION: To avoid injury, always press and hold relief valve button until pressure is released before opening filler cap.

Open filler cap and replenish system to level of filler cap opening.

DRAINING SYSTEM

Heating system and engine cooling system can each be drained separately from the other by closing two gate valves, one in each heater line. Valves are located in rear of battery compartment, and are accessible after opening battery compartment door.

Press and hold pressure relief valve button until all pressure and steam have been released. Open surge tank filler cap, then open drain cocks or remove drain plugs at points listed below.

ENGINE COOLING SYSTEM DRAIN POINTS

The following points must be opened to completely drain engine cooling system:

1. Open drain cock at bottom of engine water pump housing.
2. Remove drain plug from radiator outlet connection, located at lower rear corner of vehicle.
3. Remove hollow-head drain plug from side of air compressor cylinder head.

HEATING SYSTEM DRAIN POINTS

Four drain cocks must be opened to completely drain coach heating system. Refer to figure 10 in BODY (SEC. 3) for location of these drain cocks:

1. Open two drain cocks in front baggage compartment, providing suitable container to catch drainage. One drain cock is located in bottom of heater supply pipe, just to right of water modulation valve; the other drain cock is installed on extension tube at left of water modulation valve.
2. Open two drain cocks in driver's heater lines, located under vehicle near left front spring just rearward of front axle.

CLEANING SYSTEM

Unless water in cooling system is treated with a corrosion preventive, rust and scale will eventually clog water passages in radiator and jackets. This condition is aggravated in some localities by the formation of insoluble salts from water used.

Cleaning solutions are available which will successfully clean cooling systems of rust, scale, sludge, and grease, when used as directed by the manufacturer. However, if radiator is clogged with insoluble scale formations, reliable radiator service stations in the various localities are best equipped to remove such formations. Never use an alkaline type cleaner. Particularly at winter

check-up, preferably before and after using anti-freeze solutions, radiator and entire cooling system should be cleaned with a reliable cleaning solution.

NOTE: Always follow instructions by manufacturer of cleaning solution and equipment used.

Before pressure-flushing cooling system, tighten cylinder head bolts to prevent possible water leaks into cylinders and lubricating oil. Remove thermostat. Apply air gradually, as a clogged radiator will stand only limited pressure.

After cleaning operation is completed, be sure to check and test thermostat as described under "Engine Thermostat," earlier. Clean out overflow pipe and blow insects and dirt from radiator air passages and grille.

GMC COOLING SYSTEM CLEANER

GMC Cleaner is especially developed to remove rust, scale, and corrosion from the radiator and cylinder block water passages.

NOTE: Use cleaner only as instructed on label.

GMC COOLING SYSTEM SEALER

GMC Sealer is very effective in stopping leaks in cylinder head, water jackets and radiator. Sealer may be used with any standard antifreeze and will not clog water passages.

NOTE: Use sealer only as instructed on label.

CORROSION DAMAGE PREVENTION

Water without an inhibitor not only causes corrosion in cooling system, which interferes with circulation and cooling, but also corrosion damage to aluminum parts, such as upper and lower radiator tanks, radiator inlet and outlet fittings, engine water outlet manifold, and possibly others. Some natural waters are highly corrosive to aluminum; **HENCE, PREVENTIVE MEANS ARE NECESSARY**, particularly in the presence of ferrous metals (iron and steel).

Use of "deionized" or "soft" water (such as obtained from commercial or domestic water softener) is recommended whenever possible. "Soft" or "deionized" water aids in reducing corrosion attack on aluminum parts.

Treatment of cooling system for prevention of scale and rust formation has become an accepted automotive maintenance practice. This process consists of introducing into cooling system certain substances called "Inhibitors," which reduce or prevent corrosion of metals and deposition of scale, thus tending to maintain high cooling efficiency.

In general, inhibitors are not cleaners and will not remove scale and rust already formed. **INHIBITORS SHOULD BE USED CONTINUOUSLY,**

GENERAL COOLING SYSTEM

preferably immediately after system has been thoroughly cleaned, or when vehicle is new.

However, use of additional corrosion preventives or inhibitors is not recommended with "GM" or other antifreeze preparations already containing an inhibitor, as an excessive amount may be harmful to rubber parts.

Following are the salient points concerning recommended inhibitors:

SOLUBLE OIL

Use only in plain water and in antifreeze solutions which do not already contain an inhibitor. Use in accordance with instructions issued by the soluble oil manufacturers; supply stations have available various soluble oil inhibitors. These are marketed under different names, but their characteristics are similar.

When using soluble oil in plain water, or in uninhibited alcohol or methanol solutions, do not add too much. Soluble oil is not lost by evaporation and EXCESSIVE AMOUNTS ARE UNDESIRABLE. The amount of soluble oil in a cooling system should never exceed 1% of the volume of the system. (See Antifreeze Chart for capacity.)

GMC COOLING SYSTEM CORROSION INHIBITOR

GMC Inhibitor is a specially developed chemical water treatment, designed to prevent excessive formation of corrosion and scale. GMC Corrosion Inhibitor should be used at all times with plain water, and with uninhibited antifreeze solutions.

COLD WEATHER OPERATION

Plain water, plus an inhibitor, can be safely used as a cooling medium in climates where temperatures do not reach below 32°F. In cold regions, antifreeze must be used to prevent damage by freezing.

Before installing antifreeze solution, cooling system should be inspected and serviced for winter as previously described under "Inspection" and "Cleaning System."

Tighten cylinder head bolts and, if necessary, replace gasket, to prevent leakage of antifreeze into engine and blowing of exhaust gases into cooling system.

THAWING COOLING SYSTEM

If coolant freezes solid, place coach in a warm building until ice is completely thawed.

CAUTION: UNDER NO CIRCUMSTANCES SHOULD ENGINE BE RUN WHEN COOLING SYSTEM IS FROZEN SOLID.

ANTIFREEZE SOLUTIONS

Following information will assist in selecting

antifreeze solution best suited to meet individual driving conditions.

The most common commercial materials are:

Methanol (Methyl or Wood Alcohol)

Ethylene Glycol

Kerosene, oils, or solutions containing calcium chloride, magnesium chloride, sodium silicate potassium dichromate or other inorganic salts, honey, glucose, or sugar are not satisfactory for use in cooling system.

Methanol

Methanol is used extensively for antifreeze solutions. Methanol antifreeze solutions have the advantage of low first cost. There are, however, some disadvantages.

1. Methanol may be lost by evaporation, especially on warm days and on hard driving. Unless solution in radiator is tested periodically and sufficient antifreeze added to replace loss, engine or radiator, or both, are liable to be damaged by subsequent freezing.

2. Vehicle finish may be damaged by contact with methanol solutions or vapors. Methanol spilled on finish should be flushed off immediately with large quantity of cold water without wiping or rubbing.

Ethylene Glycol

Ethylene glycol's first cost is usually higher than that of other types of antifreeze. Ethylene glycol solutions, however, have the advantage of a higher boiling point and may be used at higher temperature without loss, resulting in more efficient performance of cooling system. Ethylene glycol has the further advantage that, in a tight system, only water is required to replace evaporation losses. However, losses through leakage or foaming must be replaced by additional new solutions. Under ordinary conditions, ethylene glycol solutions are not injurious to body finish.

"GM Ethylene Glycol" is especially treated and compounded for use in cooling systems. Other ethylene glycol preparations are available, but only those containing suitable corrosion inhibitors and compounded for use in automotive cooling systems should be used.

Testing Antifreeze Solution

Always test solution before adding water or antifreeze. Engine should be warmed up to operating temperature. Fill and empty tester several times to warm tester before using. Keep tester clean inside and out.

Some testers will indicate correct freezing point only when test is made at a specific temperature.

Other testers are provided with thermometers and tables and indicate freezing points corres-

RADIATOR, SHUTTERS, AND THERMOSTAT

ponding to readings made at various temperatures. Disregarding temperature of solution may cause an error as large as 30°F.

Some testing devices are made to test only

one kind of antifreezing solution. Others have several scales, and may be used for corresponding kinds of antifreeze. Read, and be guided by, instructions furnished with tester.

Radiator, Thermostat & Shutters

Radiator, mounted on left side of vehicle in front of engine, is accessible through radiator grille door. Surge tank, mounted in upper left-hand section of engine compartment, permits expansion of cooling liquid without loss from overflow. Excessive liquid or vapor in cooling system is exhausted through surge tank pressure valve (fig. 3) and overflow tube, which extends down side of radiator core.

Opening for filling cooling system is located in radiator surge tank. Relief valve is provided for relieving any pressure existing in system, before removing filler cap.

Radiator is designed to cool the water under all operating conditions; however, radiator core must be kept free from corrosion and scale at all times. In addition, maintenance of other cooling units must be properly performed in order to obtain satisfactory service.

RADIATOR AND SURGE TANK

MAINTENANCE

Cleaning of radiator, inspection of connections and mounting bolts, and use of corrosion preventives are essential periodic service procedures.

Radiator core should be periodically cleaned inside and out in a cleaning solution. At the same time, examine core for leaks and bent tubes, and repair, if necessary. If radiator core requires painting, spray with special radiator paint. Do not use paint mixed with oil, as this type will form an insulation on core and reduce dissipation of heat.

RADIATOR REMOVAL

To remove radiator core, when power plant is in the chassis, proceed as follows:

1. Drain system.
2. Open radiator grille door and left-hand upper closure door.
3. Remove left rear corner body panel.
4. Disconnect air line from shutter air cylinder and detach clips from overflow and vent cock pipes.
5. Remove water inlet casting from radiator top tank and outlet casting from bottom tank.
6. Remove bolts which attach radiator support channel to support brackets. Detach radiator upper bracket from bulkhead, while supporting radiator.
7. Remove radiator assembly from coach.

8. Air cylinder, shutter, shroud, baffles, and support channel may be removed from radiator, as a bench operation.

SURGE TANK PRESSURE VALVE

Mounted on surge tank, purpose of valve (fig. 3) is to improve engine performance, without danger of overheating. By maintaining a pressure in the cooling system, boiling point of coolant is raised, permitting higher engine operating temperatures, with resultant increase of engine efficiency.

Valve incorporates both a pressure valve and a vacuum valve. When pressure in system exceeds amount shown in "Specifications," pressure valve opens to relieve system of excess pressure. Purpose of vacuum valve is to permit entry of air to compensate for lowered pressure when coolant contracts.

Pressure valve reduces evaporation of coolant and prevents surging into upper tank after engine is stopped.

RADIATOR SHUTTER

Radiator shutter and control combines thermostatic control with air power actuation. With this arrangement, radiator shutter operating lever is connected to power cylinder. Operation of power cylinder is controlled by thermostat in line between engine and radiator. Thermostat is set to open and close at temperatures noted in "Specifications," at end of this section.

RADIATOR SHUTTER ASSEMBLY

Maintain radiator shutter unit in free working

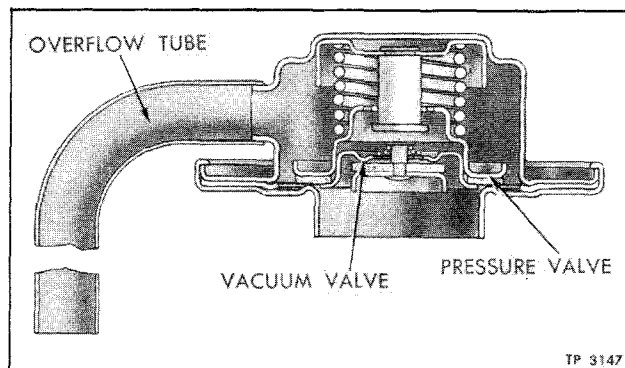


Figure 3—Sectional View of Surge Tank Pressure Valve

RADIATOR, SHUTTERS, AND THERMOSTAT

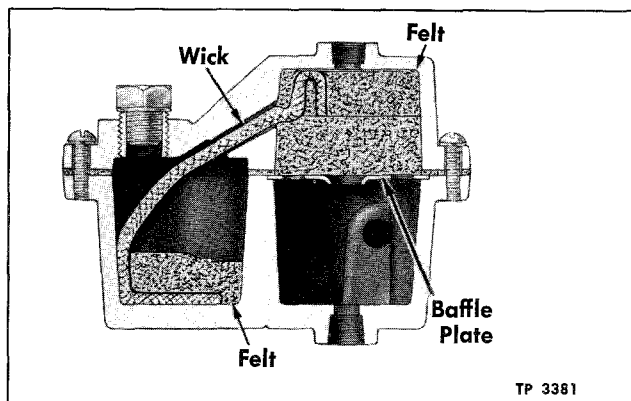


Figure 4—Sectional View of Radiator Shutter Air Filter

condition by cleaning vane bearings thoroughly with brush or spray gun, or both. Use gasoline or penetrating oil until all dirt is removed. After shutter is once worn in, lubricating oil may be omitted after cleaning. Frictional wear is very slight, and excessive lubricant may increase rapid collection of dirt. This attention is recommended every 2000 or 5000 miles, depending upon the nature of operation and the tendency toward dirt collection.

AIR FILTER

Air filter, shown in (fig. 4), prevents moisture from entering shutter thermostat. As air from air tank enters filter, it strikes against baffle which diverts moisture in air stream to bottom of housing. Air then passes through filtering element. Air is again filtered through felt before entering thermostat air valves. Periodic check should be made for leakage at filter connections. Tighten if necessary. With felt inserted, air filter chamber holds slightly over one ounce of fluid.

Add fluid to filter through filler plug. Refer to Lubrication Chart in LUBRICATION (SEC. 13), for intervals, quantity and type of fluid. Larger quantities or more frequent filling may overload system.

Air filter should be drained at intervals shown in Lubrication Chart by opening pet cock at bottom.

This operation should be performed with pressure in air lines.

Every 10,000 miles, air filter should be disassembled and the felt cleaned with cleaning solvent or replaced.

RADIATOR SHUTTER THERMOSTAT (Fig. 5)

Thermostat valve, mounted in water line between engine head and radiator, functions automatically to open and close air line to power cylinder, which operates radiator shutter.

At periodic intervals, thermostat must be cleaned by disconnecting inlet line and injecting a cleaning fluid into thermostat. Refer to Lubrication Chart in LUBRICATION (SEC. 13), for intervals, quantity, and type of fluid. When air line is reconnected, pressure will force fluid through thermostat needle valve, cleaning away any deposits of foreign matter.

Thermostat should be disassembled and cleaned once or twice per year. Disassemble by removing end caps and needle valve upper seat. Wash needle valve thoroughly in a reliable solvent. Do not use any abrasive or metal tools in removing deposits from needle valve or seats. A pointed wooden stick provides a practical method of cleaning tapered seats. Care must be taken to have all parts thoroughly cleaned before reassembling. Felts must be renewed or thoroughly washed in solvent. Do not fail to clean the small felts located in side openings.

Insert needle; then install top seat (without spring or spacing gasket) and tighten firmly against needle. Use a drop or two of oil on needle to prevent scoring. Repeat operation two or three times until new seats, both top and bottom, have been formed.

Remove top seat and needle and clean thoroughly. Install needle and spring, with small end of spring seated on shoulder of needle. Install new spacing gasket, to provide proper needle travel; then install top seat.

Testing (Fig. 5)

Before installation, thermostat should be tested for proper operation. Test can be made in a

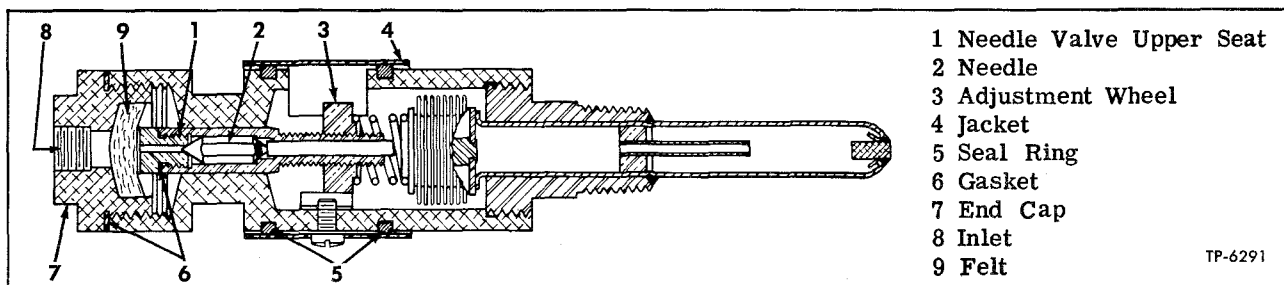


Figure 5—Sectional View of Radiator Shutter Thermostat

FAN AND WATER PUMP

water bath or by using portable tester, such as listed in SPECIAL TOOLS section, at end of this manual.

Tester has an electric heating unit, a circulating water pump, and attachments to duplicate actual conditions which exist when thermostat is installed in engine. Thermostat is inserted in tester and line protruding from top of tester is connected to end of thermostat. Air line to pressure gauge is connected to side of thermostat. After connecting electric cord and air line to tester and filling tester with water at cup at right side, instrument is ready for use. Switches at right control electric heating unit and circulating pump, and pressure gauge will indicate points at which thermostatic valve acts.

When water bath is used, connect air line to inlet port and an air pressure gauge to outlet port. Suspend thermostat in water, up to mounting threads. Use an accurate thermometer, but make sure neither thermostat nor thermometer contacts bottom of container. Raise temperature gradually to opening temperature of thermostat, keeping water thoroughly agitated. Hold water temperature constant for two or three minutes, since thermostat operation may lag on initial cycle.

Note thermometer reading at which gauge shows pressure drop - this indicates opening of thermostat.

If thermostat fails to open at temperatures listed in "Specifications," adjust to proper operating point.

Adjust thermostat by turning adjustment wheel (fig. 5). Turning wheel one full turn against spring will increase operating range approximately 10°F.

SHUTTER AIR CYLINDER

Air cylinder assembly (fig. 6) is air-actuated to open and close radiator shutter; air supply being controlled by shutter thermostat mounted

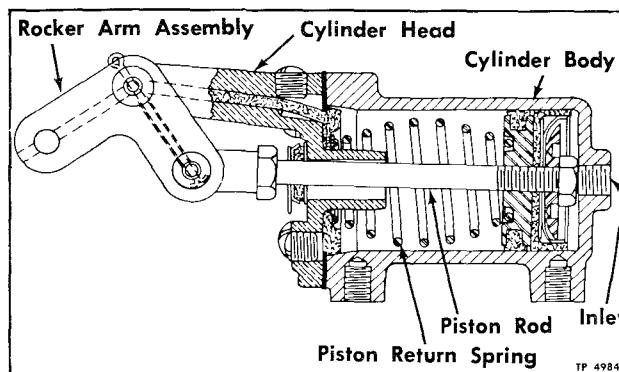


Figure 6—Sectional View of Radiator Shutter Air Cylinder

in water line between engine and radiator. Air cylinder may be tested on vehicle to determine whether cause of malfunction is in air cylinder or thermostat. This is done by disconnecting thermostat to cylinder air line and applying air pressure to disconnected air line, while observing action of cylinder. Cylinder should operate shutters at a minimum line pressure of 35 pounds.

Whenever air line has been disconnected, always check for air leaks with soap suds when air line is re-connected.

Cylinder should be removed and disassembled for cleaning and inspection at intervals of 20,000 miles. Lubricate when reassembling. Refer to LUBRICATION (SEC. 13) for interval, quantity, and type of lubricant.

When installing air cylinder, or checking linkage, make adjustment with engine cold and with sufficient air pressure to close shutter vanes. Adjust linkage to provide free pin with shutters closed.

Start engine and warm to normal operating temperature. Check shutter position, making sure shutters are fully open.

Fan And Water Pump

FAN AND DRIVE

Fan blades and hub assembly is mounted on front end of engine crankshaft. Blades are bolted to hub and can be removed by removing bolts at hub flange (fig. 7).

Hub is installed with Woodruff keys and retained on crankshaft by bolt screwed into tapped hole. Retaining bolt is locked by retainer held in place by snap ring.

FAN HUB REPLACEMENT

Fan hub consists of two cylindrical parts bonded together by rubber. Hub inner sleeve serves

to retain engine crankshaft vibration damper on shaft. Sleeve is threaded at inner bore so that puller may be used for removal.

REMOVAL (Fig. 7)

1. Remove radiator and shutter, referring to "Radiator and Shutters," earlier in this section, for instructions.
2. Remove fan blade assembly by removing six bolts at hub flange.
3. Remove snap ring, which holds bolt retainer in fan hub; then remove retainer. Using socket wrench, remove bolt screwed into end of crankshaft and remove bolt spacer.
4. Assemble special tool (CSD-1442) at fan

SPECIFICATIONS

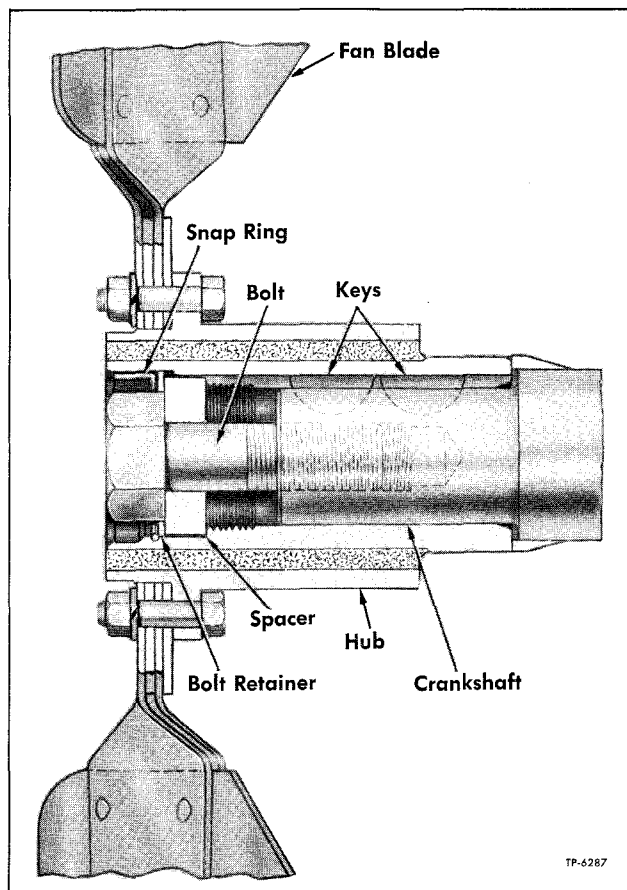


Figure 7—Fan Installation

hub, screwing hub ring into threads in hub inner sleeve; then turn puller screw to pull hub assembly from crankshaft.

INSTALLATION

1. Be sure Woodruff keys are in key slots in crankshaft.
2. Install fan hub on crankshaft and retain with bolt and spacer (fig. 7). Tighten hub retaining bolt to 180-200 ft. lbs. torque, using torque wrench.
3. Try bolt retainer over head of bolt. If retainer cannot be installed, tighten bolt sufficiently to permit installation, or try reversing position of retainer.
4. After retainer is installed secure with snap ring.
5. Install fan blades on hub; then install radiator, referring to "Radiator and Shutter," earlier in this section, for instructions.

WATER PUMP

Description and instructions for maintenance of water pump are contained in separate maintenance manual for GM Series 71 Diesel Engine, Form X-5014.

SPECIFICATIONS

COOLING SYSTEM CAPACITY

Engine, Radiator, Pipes and Fittings	56-1/2 qts.
Heating System	22-1/2 qts.
Total	79 qts.

ANTIFREEZE CHART ALL QUANTITIES LISTED IN QUARTS

Lowest Expected Temp. (Fahr.)	Methanol (Wood Alcohol)	Ethylene Glycol
+ 10°	16-1/2	20-1/2
0°	22	26
- 10°	26-1/2	30
- 20°	30-1/2	33-1/2
- 30°	34-1/2	37-1/2

NOTE: Only a permanent-type antifreeze, such as ethylene glycol, is recommended for use on vehicles equipped with radiator shutters.

THERMOSTAT - WATER CIRCULATION

Starts to Open	168°F.
Fully Opened	195°F.

TEMPERATURE GAUGE - ENGINE UNIT

Make	AC Spark Plug Div.
Type	E
Operating Range	100°F. - 220°F.
Voltage	6

SURGE TANK PRESSURE VALVE

Valve Opens (Pressure in Pounds per sq. in.)	3-1/2 - 4-1/2
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RADIATOR

Type	Fin and Tube
Frontal Area	879 sq. in.
Thickness	3-3/4 in.

RADIATOR SHUTTER THERMOSTAT

Make	Kysor
Valve Closes at	180°F.

FAN

Drive	Crankshaft
Number of Blades	6
Diameter	26"
Rotation	Counterclockwise

Electrical System

This group, covering complete maintenance and repair information on Electrical System, is divided into seven sections as shown in index below.

System	Page
Wiring and Miscellaneous Electrical	99
Battery	115
Starting System	116
Generator	121
Regulator	126
Lighting System	132
Specifications	137

Wiring and Miscellaneous Electrical

WIRING DIAGRAMS

Standard electrical system has been subdivided into four systems, each system being classified according to its function or purpose. A separate wiring diagram is provided for each of these systems. These diagrams are inserted in a pocket inside the rear cover of this manual. Following is a list of the diagrams and a brief outline of units shown on each.

Engine Control and Generator Wiring Diagram

This diagram shows generator, regulator, master fuse, and battery circuit; starter and all solenoids, relays, and switches necessary to start and stop the engine; transmission reverse solenoid, relay, and selector switch.

Alarm and Signal Wiring Diagram

This diagram shows all switches, relays, buzzer, rectifier, tell-tale lights, gauges, resistors, sending units, circuit breakers, and wiring circuits necessary for the operation and control of all audible and visual alarm and signal devices.

Lighting Wiring Diagram

This diagram shows all interior and exterior lights and their controlling switches, relays, and circuit breakers except directional, stop, and tell-

tale lights which are shown on the Alarm and Signal Wiring Diagram.

Heating and Ventilating Wiring Diagram - Without Air Conditioning

This diagram shows heaters, blowers, defrosters, thermostat, circuit breakers, and switches used on standard vehicle without air conditioning.

Heating and Ventilating Wiring Diagram - With Air Conditioning

This diagram shows heaters, blowers, defrosters, thermostat, circuit breakers, and switches used on vehicles equipped with air conditioning system. The major difference between this diagram and the one without air conditioning is in the blower rheostat and relay hook-up.

Engine Control and Generator Wiring Diagram With Moto-Gard and Air Injector Shut-Off - Special Equipment

This diagram is an Engine Control and Generator wiring diagram showing engine shut-off magnet valve, Moto-Gard, relay, rectifier, and wiring connections used as special equipment on some vehicles. Refer to "Air-Operated Injector Shut-off" later in this section.

INDEX OF ELECTRICAL UNITS

Certain electrical units, when closely associated with some other system or units, are covered in other sections of this manual. Index on next

page lists all major electrical units, together with manual section in which they are covered and page number on which the section begins.

7

WIRING AND MISC. ELEC.

INDEX OF ELECTRICAL UNITS (CONT'D.)

Unit	Section	Page	Unit	Section	Page
Batteries	7	115	Rectifier	7	99
Blower Motors	3	29	Regulator	7	126
Buzzer, Tell-tale Alarm	7	99	Relays.	7	99
Chime, Passenger Signal	3	29	Resistors	7	99
Circuit Breakers	7	99	Solenoids	7	99
Defroster	3	29	Speedometer	7	99
Fog Light	7	132	Starter	7	116
Gauge, Oil Pressure	8	141	Switch, Emergency Door	3	29
Gauge, Water Temperature.	6	89	Switches, Heater Magnetic.	3	29
Generator	7	121	Switches, Lighting	7	132
Head Lights	7	132	Switch, Low Air Pressure	4	43
Heater Motors	3	29	Switch, Low Oil Pressure	8	141
Horn	7	99	Switch, Passenger Chime	3	29
Lights	7	132	Switch, Stop Light	7	132
*Magnet Valve, Injector Shut-off . .	7	99	Tell-Tale Lights	7	99
*Moto-Gard	7	99	Thermostat, Engine Overheat	6	89
Panels-Gauge, Switch, and Junction .	7	99	Thermostat, Heating System	3	29
*Special Equipment					

TESTING CIRCUITS

A careful study of wiring diagrams should be made to determine the source and flow of current through each electrical circuit. When a circuit is thoroughly understood, a point to point check can be made, with the aid of the applicable wiring diagram, to determine location of trouble.

Methods of testing some circuits are described in other sections of this manual. However, circuits may be tested for continuity or shorts with

test light or low-reading voltmeter.

All electrical connections must be clean and tight. Loose or corroded connections will cause discharged battery, difficult starting, dim lights, and improper functioning of other electrical units. Inspect all wiring and connections at regular intervals. Refer to sections previously listed under "Index of Electrical Units" for maintenance instructions on various units and circuits.

WIRE SIZES AND TRACER COLORS

Each wire in the electrical system is of a specific size as designated on Wiring Diagrams. When replacing wires, the correct size as indicated must be used. Never replace a wire with one of a smaller size.

The insulation on each wire is distinctly patterned and colored to assist in tracing and testing circuits, also to assist in making correct connections.

Abbreviations and symbols are used in wire insulation color and pattern designations on Wiring Diagrams and in the tabulations which follow.

These abbreviations and symbols are explained below.

*Blk.	Black	Nat.	Natural
Br.	Brown	Tr.	Tracer
Ch.	Check	Yell.	Yellow
Cr.	Cross	//	Parallel
Gr. or Grn. . .	Green		

* All wires used in engine compartment are covered with black heat-resistant insulation. To assist in making proper connections, a tag near end of each wire bears the number or abbreviation of the terminal to which it connects.

GAUGE PANEL

Gauge panel (fig. 1) is mounted directly in front of driver at left of steering column. All gauges except "Air Pressure" are electrically operated. In addition to gauges, panel includes seven tell-tale lights which are visible only when illuminated. Following is a list of all gauges and tell-tales included in gauge panel:

1. Air Pressure Gauge
2. Speedometer

3. Oil Pressure Gauge
4. Engine Water Temperature Gauge
5. Head Light "HI BEAM" Tell-tale
6. Generator "NO CHARGE" Tell-tale
7. "STOP LAMP" Tell-tale
8. "EMERG. DOOR" Tell-tale
9. "LOW AIR" Pressure Tell-tale
10. "LOW OIL" Pressure Tell-tale
11. "HOT ENG." Tell-tale

WIRING AND MISC. ELEC.

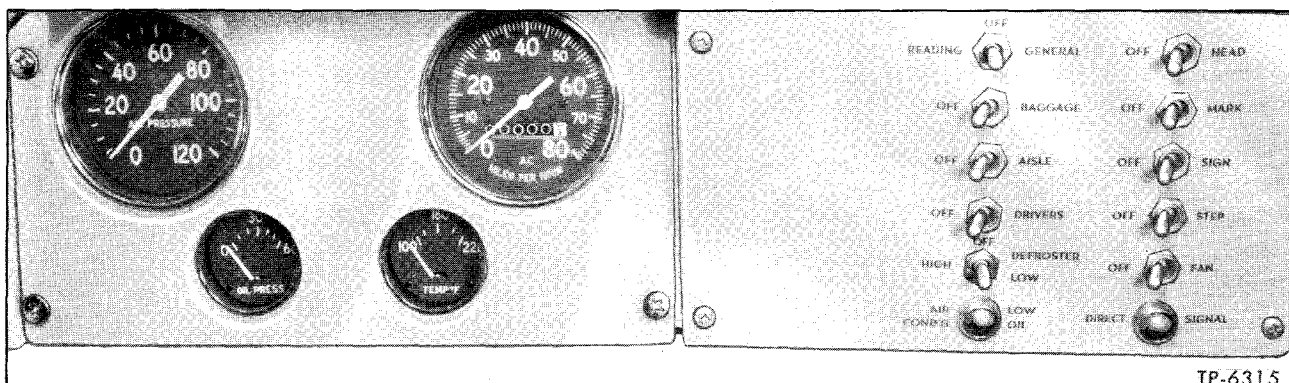


Figure 1—Gauge and Switch Panels Installed

SWITCH PANEL

Switch panel (fig. 1) is mounted directly in front of driver at right of steering column. This panel contains switches for control of all lighting circuits and for windshield defroster. Some lighting circuits are further controlled by other switches, located elsewhere in the vehicle (refer to "LIGHTING SYSTEM" later in this group). This panel also includes the directional signal tell-tale

light and the air conditioning low oil tell-tale (when used). Refer to "Coach Lighting Wiring Diagram" in back of manual when tracing circuits and for junction panel terminal and circuit breaker identification. Wires extending from circuit breaker and junction panel through switches are contained in a single harness assembly.

CONTROL PANEL

The control panel (fig. 2) is located at the left of the driver on body inside panel. Panel contains engine "CONTROL" switch, "START" switch, "EMERGENCY STOP" switch, "REVERSE SELECTOR" switch, "DRIVER'S HEATER" rheostat switch, "BLOWER" rheostat switch, and "HEATING" switch. When vehicle is equipped with air conditioning, panel also contains air conditioning controls. On some vehicles, a key type control circuit lock is connected in series in the control switch feed wire; when this lock is used, it is mounted on control panel adjacent to the "CONTROL" switch.

in accordance with Wiring Diagram. Failure to do this may cause switch to work opposite to markings on front of panel.

PANEL REMOVAL

Removal of control panel assembly is easily accomplished by removing six screws attaching control panel to body panel. Panel can then be lifted outward and turned face down to reach wire terminals at rear of panel, and relays which are installed behind panel (fig. 7).

UNIT REPLACEMENT

When replacing individual units on control panel, the following precautions should be taken. If wire insulation color and pattern are not clearly discernible, tag each wire as it is removed and note terminal to which it attaches. When installing units, make sure wires are connected to proper terminals as marked at time of removal, or

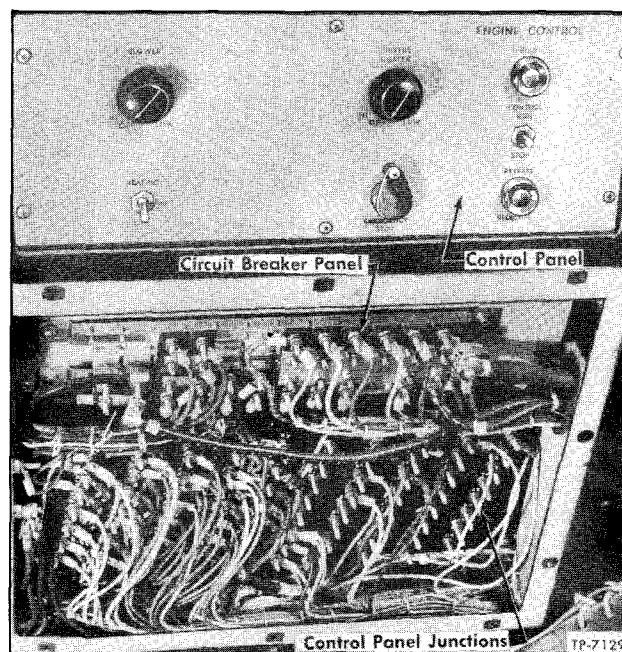


Figure 2—Driver's Control Panel, Circuit Breaker Panel, and Junction Panel

GM COACH MAINTENANCE MANUAL

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CIRCUIT BREAKER PANEL

Circuit breaker panel is mounted below control panel at left of driver (fig. 2). Panel contains 16 automatic circuit breakers (18 when equipped with air conditioning). Circuit breakers protect various electrical circuits as indicated in the tabulation which follows. Circuit breaker numbers shown on

Wiring Diagrams and in the tabulation which follows do not appear on the circuit breakers or on the panel. To identify circuit breakers, it is necessary to refer to the following diagram, or to a similar diagram which is attached to the back of the circuit breaker and junction panel cover.

CIRCUIT BREAKER IDENTIFICATION

#1 20 Amp.	#2	#3 15 Amp.	#4 15 Amp.	#5	#6	#7 20 Amp.	#8 20 Amp.	#9 20 Amp.	#10 20 Amp.	#11 20 Amp.	#12 20 Amp.
#13 30 Amp.	#14 30 Amp.	#15 20 Amp.	#16 20 Amp.	#17 20 Amp.	#18 20 Amp.	#19 20 Amp.	#20	#21	#22 20 Amp.	#23	#24 30 Amp.

CIRCUIT BREAKER TABULATION

The following tabulation lists each circuit breaker number (as identified by chart above), size (amps.), the circuit it protects, and the size, color, and pattern of wire (or wires) which con-

nect to the circuit breaker terminal. Numbers 2, 5, 6, 20, 21, and 23, marked "open" in tabulation, may be used with special electrical equipment.

Circuit Breaker No.	Amps.	Circuit	Wire Size & Color
1	20	*Evaporator Blower Control	No. 16 Nat. - Green & Red // Tr.
2	--	Open	
3	15	Left-hand Outside Air Blower . . .	No. 14 Blue - 2 Nat. // Tr.
4	15	Right-hand Outside Air Blower . .	No. 14 Blue - Red Tr.
5	--	Open	
6	--	Open	
7	20	Horn	No. 10 Red - Nat. Cr. Tr.
		Stop Light	No. 16 Yellow - Red Tr.
8	20	Step, Aisle, & Driver's Lamp . . .	No. 14 Yellow - 2 Blk. // Tr. <i>Red 3 Blk. 14 Tr.</i>
9	20	Driver's Fan	No. 14 Brown - Red Tr. <i>Red 3 Blk. 14 Tr.</i>
		Baggage Compartment Lamps . . .	No. 16 Brown - Red Tr. <i>Red 3 Blk. 14 Tr.</i>
10	20	Destination Sign & Marker Lights .	No. 14 Nat. - Blk. Tr. <i>Red 3 Blk. 14 Tr.</i>
11	20	Head & Fog Lamps	No. 14 Black - 2 Gr. // Tr. <i>Red 3 Blk. 14 Tr.</i>
12	20	Reading & General Lighting Control	No. 16 Black - Nat. Tr. <i>Red 3 Blk. 14 Tr.</i>
		Directional Signal Lights	No. 16 Black - Yellow Cheek
13	30	Left Side Reading Lamps	No. 8 Black - Nat. Tr.
14	30	Right Side Reading Lamps	No. 8 Black - Green Tr.
15	20	Blower Relay	No. 14 Green - Nat. Tr.
16	20	Starter & Reverse/Volt. Governor .	No. 16 Nat. - 2 Green // Tr. <i>14 Red</i>
		Diesel Control Switch	No. 12 Green - Nat. Tr.
		Alarm & Telltale	No. 14 Nat. - 2 Green // Tr.
17	20	Engine Stop	No. 14 Green
18	20	Heater Magnetic Switches	No. 16 Black - Brown Cr. Tr.
		Driver's Heater	No. 14 Black - 2 Red // Tr.
19	20	Defrosters	No. 16 Yellow - 2 Black // Tr.
20	--	Open	
21	--	Open	
22	20	*Air Conditioning Engine Choke .	No. 14 Black - Nat. Cr. Tr.
23	--	Open	
24	30	General Lighting	No. 6 Black - Red Tr.

*When Equipped With GM Air Conditioning.

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DRIVER'S CONTROL PANEL JUNCTIONS

Control panel junction (fig. 2) is located below the circuit breaker panel at the left of the driver. Panel contains terminals numbered from 39 through 118. Numbers on panel correspond to numbers on Wiring Diagrams and in the tabulation which follows. Remove circuit breaker and junction panel cover for access to terminals.

The following tabulation lists each terminal number, the circuit it carries, and the size, color, and pattern of the wire (or wires) which connect to the terminal. Some of the unused terminals, marked open or spare in tabulation, may be used with special electrical equipment.

Refer to Symbol  on Wiring Diagrams

Terminal No.	Circuit	Wire Size & Color
39	Front Marker Lights	No. 16 Nat. - Black Tr.
	Instrument Lights	No. 16 Nat. - Black Tr.
	Taillights & Highway Sign	No. 14 Nat. - Black Tr.
40	Rear Marker Lights	No. 16 Nat. - Black Tr. <i>12 Gr.</i>
	Feed From "Markers" Switch	No. 14 Nat. - Black Tr.
41	Driver's Fan	No. 16 Brown - 2 Red <i>// Tr. 14 Gr. 1/2 Tr.</i>
42	Low Air Tell-tale	No. 16 Red - Nat. Tr.
43	Open	
44	*Air Cond. Start Switch	No. 14 Green - Red Tr.
45	Driver's Heater	No. 14 Brown - Green Tr.
46	Feed From No. 12 Circuit Breaker	No. 16 Black - Yellow Ch. <i>14 Gr. 1/2 Tr.</i>
	Directional Signal Switch	No. 16 Black - Yellow Ch. <i>12 Gr.</i>
	General & Reading Light Switch	No. 16 Black - Nat. Tr.
47	Left-hand Directional Lights	No. 16 Nat. - Black Cr. Tr. <i>14 Red</i>
48	Right-hand Directional Lights	No. 16 Nat. - Red Cr. Tr. <i>14 Red/304</i>
49	Reverse Selector Switch	No. 16 Nat. - 2 Red <i>// Tr.</i>
50	Generator Tell-tale	No. 16 Brown - Nat. Cr. Tr. <i>12 Gr.</i>
51	Destination Sign	No. 16 Brown - Black Cr. Tr.
52	Horn Button	No. 16 Brown - Red Ch.
53	Horn	No. 10 Brown - Blk & Red Cr. Tr.
54	*Air Cond. Start Switch Feed	No. 14 Green - Red Ch.
55 thru 58	Open	
59	Starter Switch	No. 16 Red - Green Tr.
60	Emergency Stop	No. 14 Nat. - Gr. & Red Cr. Tr.
61	Emergency Door Tell-tale	No. 16 Blue - Black Tr.
62	Entrance Door Step Light Switch	No. 16 Yellow - 2 Blue <i>// Tr.</i>
63	Open	
64	*Air Cond. Low Oil Tell-tale	No. 16 Nat. - Red Ch.
65	Left-hand Directional Lights	No. 16 Orange - Black Tr.
66	Right-hand Directional Lights	No. 16 Orange - Green Tr.
67 & 68	Open	
69	Low Oil Tell-tale	No. 16 Nat. - Blk. & Gr. Cr. Tr.
70	Spare to No. 12 Engine Compartment Jct.	Green - Nat. Cr. Tr.
71	Passenger's Signal	No. 16 Orange
72	Step Lamp & No. 1 Right Side Aisle Light	No. 16 Blue
73	Open	
74	*Air Conditioning Choke	No. 14 Black - Nat. Cr. Tr.
75	Defrosters	No. 16 Yellow - Blue Tr.
76 thru 78	Open	
79	Engine Overheat Tell-tale	No. 16 Yellow
80	Stop Lamp Tell-tale	No. 16 Red - Black Tr.
81	Open	
82	Aisle Lamps	No. 16 Red - 2 Nat <i>// Tr.</i>
83 thru 88	Open	
89	Oil Gauge	No. 16 Nat. - Blk. & Gr. <i>// Tr.</i>
90	*Air Cond. Throttle Thermostat	No. 14 Red - 2 Gr. <i>// Tr.</i>
91	Right Side Blower	No. 14 Blue - Red Tr.
92	Baggage Compartment Lamps	No. 16 Brown - Red Tr.
93	Open	
94	Feed From No. 16 Circuit Breaker	No. 14 Nat. - 2 Gr. <i>// Tr.</i>
	Passenger Signal	No. 16 Orange - Nat. Tr.
	Tell-tales & Alarm Buzzer	No. 16 Nat. - 2 Gr. <i>// Tr.</i>
	Speedometer Drive Unit	No. 14 Nat. - 2 Gr. <i>// Tr.</i>

*When Equipped With Air Conditioning.

Continued on Next Page

WIRING AND MISC. ELEC.

DRIVER'S CONTROL PANEL JUNCTIONS (CONT'D.)

95 thru 98	Open	
99	Engine Temperature Gauge	No. 16 Nat. - 2 Blk. // Tr.
100	Driver's Lamp	No. 16 Yellow - Black Tr.
101	Left Side Blower	No. 14 Blue - 2 Nat. // Tr.
102	Heater Magnetic Switch Feed	No. 16 Black - Brown Cr. Tr.
103	*Air Conditioning Blower Control	No. 14 Nat. - Gr. & Red // Tr.
	*Air Conditioning Test and Safety Switches	No. 14 Nat. - Gr. & Red // Tr.
104	Head & Fog Light Selector Switch	No. 14 Black - 2 Gr. // Tr.
105 thru 108	Open	
109	Engine Stop	No. 14 Green
110	Spare to No. 13 Engine Compartment Jct. . .	Green - Brown Cr. Tr.
111	Left Side Reading Lights	No. 8 Black - Nat. Tr.
112	Right Side Reading Lights	No. 8 Black - Green Tr.
113	General Lighting	No. 6 Black - Red Tr.
114	Hi-Beam Tell-tale	No. 16 Nat. - Green Cr. Tr.
115	Spare to Body Jct.	Green - 2 Brown // Tr.
116 thru 118	Open	

*When Equipped With Air Conditioning.

BODY JUNCTION PANEL

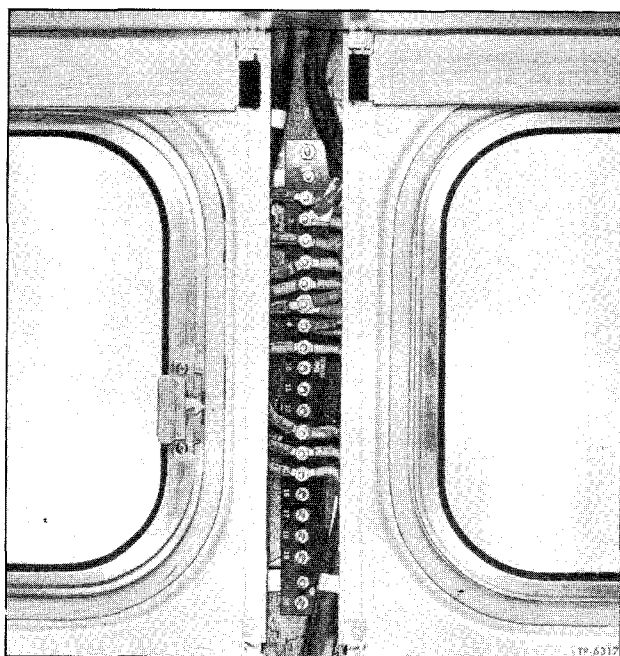


Figure 3—Body Junction Panel (Between First and Second Windows on Left Side)

A body junction panel is located between the first and second passenger windows at the left front side of the vehicle (fig. 3).

Junction terminals are accessible after removing trim panel from between windows as follows:

1. Raise first and second window shades as far as possible.
2. Use cross-recessed screw driver to remove four screws from window shade guide. Two screws are located in guide at rear of first window and two are in guide at front of second window.
3. After removing screws, trim panel can be completely removed for access to junction terminals.

Junction panel contains 20 terminals, numbered consecutively from 1 to 20. Numbers on panel correspond to numbers shown on Wiring Diagrams and in the tabulation which follows. The tabulation following lists each terminal number, the circuit it carries, and the size, color, and pattern of the wire (or wires) which connect to the terminal. Some of the unused terminals, marked open in tabulation, may be used with certain special electrical equipment.

Refer to Symbol  on Wiring Diagrams.

Terminal No.	Circuit	Wire Size & Color
1	Open	
2	Rear Marker Lights	No. 16 Nat. - Black Tr.
3	Right Side Reading Lights	No. 8 Black - Gr. Tr.
4	Emergency Door Switch	No. 16 Blue - Black Tr.
5	Left Side Reading Lights	No. 8 Black - Nat. Tr.
6	*Evaporator Blower Control	No. 14 Nat. - Gr. & Red // Tr.
7	Feed From No. 113 Control Panel Jct. . .	No. 6 Black - Red Tr.
	Right Side General Lights	No. 8 Black - Red Tr.
	Left Side General Lights	No. 10 - Black - Red Tr.
8	Right Side Blower	No. 14 Blue - Red Tr.
9	Left Side Blower	No. 14 Blue - 2 Nat. // Tr.
10 thru 14	Open	
15	*Throttle Thermostat	No. 14 Red - 2 Gr. // Tr.
16 thru 20	Open	

*When Equipped With Air Conditioning.

WIRING AND MISC. ELEC.

ENGINE COMPARTMENT PANEL

Engine compartment panel (fig. 4) is located at right rear corner of vehicle in the engine compartment. Inner side of panel is accessible from the engine compartment after removing panel cover. Cover is attached to panel with nine cross-recessed head screws. Outer side of panel is accessible after opening small access door at right rear corner of vehicle. The following units are mounted on inner side of panel:

Engine Compartment Junction Panel
Reverse Relay
Starter Relay
Stop Light Relay
Engine Comp't. Light, Stop Light, Starter
and Generator Tell-tale Circuit Breakers

Moto-Gard and Relay are also mounted on inner side of panel (when used).

Regulator and Master Fuse are mounted on outer side of panel.

"ENGINE START" switch, "COMPARTMENT LAMP" switch, and "START CUT-OUT" switch are mounted on rear edge of panel.

Junction panel contains twenty-eight terminals, consecutively numbered from 1 to 28. The tabulation which follows lists each terminal number, and the size, color, and pattern of the wire (or wires) which connect to the terminal.

All wires leading from the junction panel to units in the engine compartment are insulated with black heat-resistant insulation. These wires are identified by a tag near end of each wire

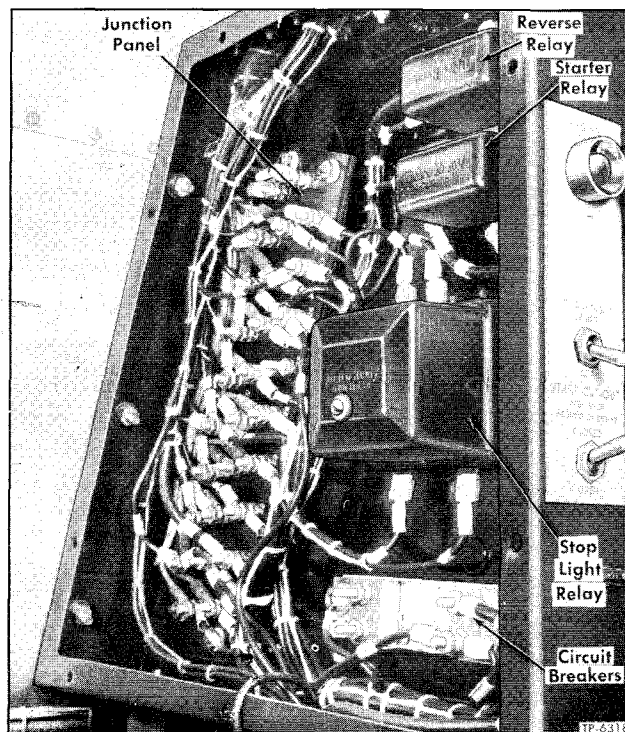


Figure 4—Engine Compartment Panel with Cover Removed

which bears the number of the terminal to which it connects, or an abbreviation of the name of the unit to which it connects.

Refer to Symbol ☐ on Wiring Diagrams

Terminal No.	Circuit	Wire Sizes & Color
1	Taillights & Highway Sign	No. 14 Nat. - Black Tr.
2	Feed From No. 109 Control Panel Jct. To Engine Stop Solenoid	No. 14 Green No. 14 Black
3	Feed From No. 99 Control Panel Jct. To Temp. Gauge Engine Unit	No. 16 Nat. - 2 Black // Tr. No. 16 Black
4	Ground For Reverse Relay	No. 14 Black
5	Feed From No. 69 Control Panel Jct. To Low Oil Pressure Switch	No. 16 Nat. - Black & Gr. Cr. Tr. No. 16 Black
6	Feed From No. 79 Control Panel Jct. To Engine Overheat Thermostat	No. 16 Yellow No. 16 Black
7	Feed From No. 94 Control Panel Jct. To Speedometer Drive Unit	No. 14 Nat. - 2 Gr. // Tr. No. 14 Black
8	Feed From No. 47 Control Panel Jct. To Left Side Rear Directional Light	No. 16 Nat. - Black Gr. Tr. No. 16 Black
9	Feed From No. 48 Control Panel Jct. To Right Side Rear Directional Light	No. 16 Nat. - Red Cr. Tr. No. 16 Black
10	Feed From No. 49 Control Panel Jct. To Reverse Relay "Vac." Terminal	No. 16 Nat. - 2 Red // Tr. No. 16 Black
11	Reverse Relay to Reverse Solenoid	No. 10 Black
12	Spare From No. 70 Control Panel Jct.	Green - Nat. Cr. Tr.
13	Spare From No. 110 Control Panel Jct.	Green - Br. Cr. Tr.
14	Feed From No. 89 Control Panel Jct. To Oil Gauge Engine Unit	No. 16 Nat. - Blk. & Gr. // Tr. No. 16 Black
15	From D Terminal on Speedometer Dash Plug To B Term. on Speedometer Drive Unit	No. 16 Black - 2 Br. // Tr. No. 16 Black
16	From A Term. on Speedometer Dash Plug To A Term. on Speedometer Drive Unit	No. 16 Brown - Nat. & Blk. Cr. Tr. No. 16 Black

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WIRING AND MISC. ELEC.

ENGINE COMPARTMENT PANEL (CONT'D.)

Terminal No.	Circuit	Wire Size & Color
17	From C Term. on Speedometer Dash Plug To C Term. on Speedometer Drive Unit	No. 16 Green - 2 Red // Tr. No. 16 Black
18	From B Term. on Speedometer Dash Plug To D Term. on Speedometer Drive Unit	No. 16 Nat. - Blk. & Red // Tr. No. 16 Black
19	Feed From No. 60 Control Panel Jct. To Emergency Stop Solenoid	No. 14 Nat. - Gr. & Red Cr. Tr. No. 14 Black
20	From No. 50 Control Panel Jct. To Engine Compartment Panel Circuit Breaker	No. 16 Brown - Nat. Cr. Tr. No. 16 Black
21	Starter Relay to Starter Solenoid	No. 10 Black
22	Engine Compartment Lights	No. 16 Black
23	Feed From No. 59 Control Panel Jct. To Starter Relay	No. 16 Red - Gr. Tr. No. 16 Black
24	From 1 Term. on Stop Light Relay To No. 80 Control Panel Jct.	No. 16 Black No. 16 Red - Blk. Tr.
25	Open	
26	Stop Light Relay 3 Term. to Stop Light Switch	No. 14 Black
27	Stop Light Relay 4 Term. to Left Side Stop Lights	No. 16 Black
28	Stop Light Relay 5 Term. to Right Side Stop Lights	No. 16 Black

ALARM SYSTEM RECTIFIER PANEL

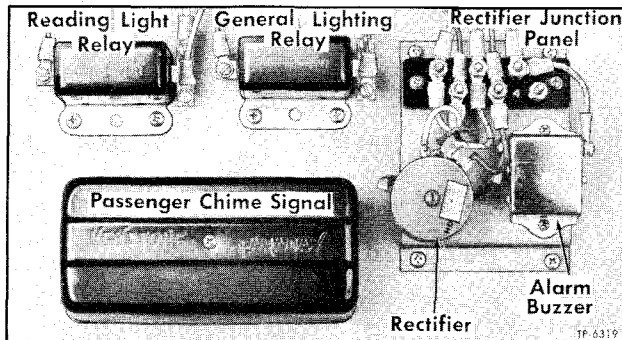


Figure 5—Alarm Buzzer, Rectifier, Passenger Chime Signal, and Lighting Relays Installed

Alarm buzzer and rectifier panel (fig. 5) is mounted on driver's compartment front trim panel forward of the switch panel. Passenger chime signal, reading light relay, and general lighting relay are also mounted on drivers front trim panel. Rectifier junction panel has six terminals numbered 1 through 6. The following tabulation lists each terminal, the circuit it carries, and the size, color, and pattern of the connected wires.

Refer to Symbol  on Alarm

and Signal Wiring Diagram in

back of manual.

Terminal No.	Circuit	Wire Size & Color
1	Engine Overheat Tell-tale & Alarm	No. 16 Yellow
2	Low Oil Pressure Tell-tale & Alarm	No. 16 Nat. - Black & Gr. Cr. Tr.
3	Alarm Buzzer	No. 16 Nat. - 2 Gr. // Tr.
4	Open	
5	Low Air Tell-tale & Alarm	No. 16 Red - Nat. Tr.
6	Emerg. Door Tell-tale & Alarm	No. 16 Blue - Black Tr.

BATTERY JUNCTIONS

Battery junctions are located at three easily accessible points on the vehicle. Battery cables, carrying current to various parts of the vehicle for operation of switches, lights, and other units, are connected to these junctions. Location of battery cable junctions are as follows:

1. Engine Compartment Battery Junction, located above engine compartment control panel at master fuse - accessible through access door in

right rear corner of vehicle

2. Control Panel Battery Junction, located at forward end of circuit breaker panel at left of driver - accessible after removing circuit breaker and control junction panel cover.

3. Heating and Air Conditioning Battery Junction, located on rear side of front spring rear bulkhead - accessible after opening forward baggage compartment door on left-hand side.

WIRING AND MISC. ELEC.

TELL-TALE ALARM SYSTEM

TELL-TALE LIGHTS

Eight tell-tale lights are used on each vehicle having a standard electrical system. Seven of these tell-tales are located on gauge panel in front of driver, and are visible only when illuminated. The directional signal tell-tale is located on switch panel in front of driver (fig. 1). Air conditioning low oil tell-tale, also shown on switch panel in figure 1, is used only on vehicles equipped with air conditioning. Refer to "Alarm and Signal Wiring Diagram" in back of manual for tell-tale light circuits. Following is a list of all standard tell-tale lights and their function.

1. "LOW OIL" - This tell-tale indicates that engine oil pressure has dropped below 3 pounds. Engine should be stopped immediately and the low oil condition corrected.

2. "HOT ENG." - This tell-tale indicates that temperature of engine is too high for safe operation. Engine should be stopped immediately and the overheated condition corrected.

NOTE: When coach is equipped with "MOTO-GARD," low oil or hot engine will cause engine to stop automatically. There is, however, a time lag of approximately 25-35 seconds from the time the tell-tale illuminates until the engine is stopped. This provides time to guide vehicle to safety before the actual stop occurs. Operation of "MOTO-GARD" system is explained later.

3. "LOW AIR" - This tell-tale indicates that air pressure is below 54 to 66 pounds. This pressure will not efficiently operate brakes. If vehicle is moving and tell-tale illuminates, stop vehicle immediately and correct cause of air pressure loss.

4. "EMERG. DOOR" - This tell-tale indicates that emergency door is open or partially unlatched. Coach should be stopped and emergency door securely latched for passenger safety.

5. "NO CHARGE" - This tell-tale indicates that the generator is not charging, or is not producing sufficient output to handle the electrical load.

6. "HI BEAM" - This tell-tale illuminates when head light high beam is being used.

7. "STOP LAMP" - This tell-tale illuminates when brakes are applied to indicate normal functioning of stop lights. If tell-tale fails to illuminate when brakes are applied, it is an indication that one or more stop light bulbs are burned out.

8. "DIRECT. SIGNAL" - This tell-tale flashes on and off when directional signals are being used to indicate normal functioning of signals. If tell-

tale fails to illuminate when directional signal lever is moved to either right or left turn position, it is an indication of burned out directional signal bulb.

When either of the first four tell-tales listed above illuminate, a buzzer sounds to audibly warn the driver that some abnormal condition exists. Tell-tale alarm system is operative only when "CONTROL" switch is in "RUN" position, with the following exception: On some vehicles, the emergency door tell-tale circuit is fed hot, and will operate whenever the emergency door is unlatched regardless of the position of any other switches.

TELL-TALE ALARM BUZZER

Tell-tale alarm buzzer, rectifier, and rectifier junction panel are mounted on driver's compartment front trim panel at right of steering column, below the switch panel (fig. 5). Alarm buzzer is interconnected with four tell-tale lights as previously explained under "Tell-Tale Lights" to audibly warn the driver of some abnormal condition. Vehicle should not be moved while buzzer is sounding. If buzzer sounds while vehicle is moving, vehicle should be stopped immediately and the abnormal condition corrected. Refer to "Alarm and Signal Wiring Diagram" in back of manual for alarm buzzer circuit.

NOTE: When "CONTROL" switch is placed in "RUN" position and before the engine is started, "NO CHARGE," "LOW OIL," and "LOW AIR" tell-tale lights will illuminate and the buzzer will sound. The tell-tales will remain illuminated and buzzer will continue to sound even after engine has started until oil pressure is above 3 pounds, air pressure above 54-66 pounds, and generator is charging.

BUZZER MAINTENANCE

Buzzer contact points should be inspected periodically and cleaned when necessary. Remove buzzer cover for access to points.

As a safety precaution, emergency door buzzer should be checked daily. Place engine control switch in "RUN" position and unlatch emergency door. Buzzer should sound. If buzzer fails to sound, test as follows:

1. If buzzer fails to sound with control switch in "RUN" position and emergency door unlatched, check for defective circuit breaker (No. 16 on circuit breaker panel) by connecting a jumper wire across circuit breaker terminals. If buzzer sounds, circuit breaker is defective and must be replaced. If buzzer fails to sound, check circuit

WIRING AND MISC. ELEC.

continuity, using a voltmeter or a test light having a 12-volt, 1.5 candlepower bulb, as follows:

2. Control switch must be in "RUN" position and emergency door unlatched. With one test lead grounded, touch other lead to each buzzer terminal. If no current is obtained at either terminal, defective wiring between control panel and buzzer is indicated.

3. If current is indicated at one terminal, ground the dead terminal with a jumper wire. Buzzer should sound. If buzzer fails to sound, remove buzzer for repair or replacement.

4. To check for defective rectifier, connect jumper lead from number 6 rectifier junction terminal to buzzer terminal (next to rectifier). If buzzer sounds, rectifier is defective and must be replaced.

5. To test circuit (except buzzer and rectifier), connect voltmeter or test light leads to rectifier junction terminals as follows: 1 and 3, 2 and 3, 5 and 3, 6 and 3. (Engine must be stopped, emergency door unlatched, and control switch in "RUN" position when making these tests.) If current is not obtained in one or more of these tests, refer to "Alarm and Signal Wiring Diagram" to determine which circuit is defective.

6. If current indication is not obtained, switches and wiring should be carefully checked for open circuit.

ALARM SYSTEM RECTIFIER

Rectifier, mounted on driver's compartment trim panel ahead of steering column, is connected in series between the tell-tale lights and the alarm buzzer (refer to "Alarm and Signal Wiring Diagram" in back of manual). Rectifier permits current flow in one direction only, thus preventing more than one tell-tale light from illuminating when only one abnormal condition exists. Rectifier requires no maintenance other than making sure that leads are securely soldered to terminals. To test for defective rectifier, accomplish step 4 under "Buzzer Maintenance."

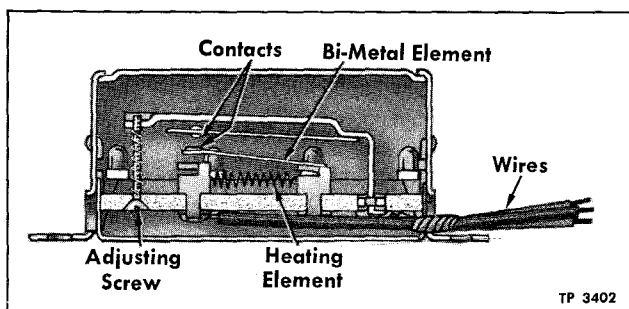


Figure 6—Moto-Gard Unit

ALARM SWITCHES

The audible alarm system is controlled by four switches, each of which controls an electrical circuit. These four circuits are: (1) Low Oil Pressure, (2) Water Overheat, (3) Low Air Pressure, and (4) Emergency Door Open.

Whenever any of these conditions exist, the switch controlling that circuit is closed, completing the circuit to tell-tale and alarm buzzer. These circuits, on standard vehicle, are operative only when engine control switch is in run position. Refer to "Alarm and Signal Wiring Diagram" in back of manual for electrical circuits.

Maintenance, tests, and location of these switches are described in other sections of this manual as previously indicated under "Index of Electrical Units."

MOTO-GARD

Air-operated injector shut-off system, which automatically stops engine when control switch is placed in off position, is used as special equipment on some vehicles. Operation and maintenance of this system is explained in ENGINE (SEC. 8).

Moto-Gard system is used in conjunction with the air injector shut-off system on some installations. Moto-Gard system comprises the Moto-Gard unit, which is a thermal type switch, a rectifier, and a relay, all mounted on engine compartment control panel. These units are interconnected with the water overheat and low oil tell-tale alarm system and the air injector shut-off magnet valve as shown on special wiring diagram in back of manual. Operation of system follows:

Relay and Moto-Gard unit are both connected to "RUN" side of Diesel control switch. Relay points are normally closed, thus magnet valve is always energized with control switch in "RUN" position, and air pressure is exhausted from injector shut-off air cylinder. When engine overheat thermostat or low oil pressure switch contacts close, circuit is completed through Moto-Gard heating element (fig. 6). Heat created in heating element causes bi-metal contact arm to bend, closing contacts. This completes circuit through relay winding, causing relay points to open and interrupt circuit to injector shut-off magnet valve. With magnet valve de-energized, air pressure is admitted to injector shut-off air cylinder, and injector racks are moved to no-fuel position.

Action of Moto-Gard is not immediate, as it requires 25 to 35 seconds for the unit to heat up sufficiently to close the contacts. Purpose of rectifier used with this system is to prevent back feed of current from causing the system to function when the overheat thermostat or low oil pressure switch contacts are open.

WIRING AND MISC. ELEC.

NOTE: When starting engine, circuit through low oil pressure switch is immediately completed, and Moto-Gard heating element starts to heat up as soon as control switch is placed in "RUN" position. If engine fails to start during time required for Moto-Gard contacts to close (25 to 35 seconds), Moto-Gard will cause injector racks to be moved to no-fuel position. It is then necessary to turn control switch off and wait approximately 30 seconds for Moto-Gard heating element to cool, then place control switch in "RUN" position and again attempt to start engine.

MOTO-GARD TEST

Start engine and run for a few minutes to build up pressure in air system. Open engine compartment door at rear of vehicle. Ground engine overheat thermostat terminal and check time lapse before Moto-Gard acts to stop engine. Time should be 25 to 35 seconds. If longer time is required, Moto-Gard requires adjustment. If engine does not stop within one minute, Moto-Gard system is not functioning. Check relay and magnet valve operation and repair or replace if necessary. If Moto-Gard system still fails to stop engine, replace Moto-Gard unit.

RELAYS

Relays are magnetic switches used to provide control for numerous electrical circuits. Through the use of a relay, it is possible to automatically open or close a circuit as operating conditions may require. Usually when a relay is used, it is possible to eliminate great lengths of heavy cable, thereby providing higher voltage to operating units. Some relays used on these vehicles are the same even though they are used in different circuits and for different purposes. Relay contacts may be cleaned with a fine cut contact file.

Refer to Wiring Diagrams in back of manual for wire size and color, junction terminals, and relay terminal identification.

LIGHTING, REVERSE, STARTER, AND BLOWER RELAYS

Relays used in the general and reading light circuits, starter circuit, and blower circuit are all identical. Lighting relays are mounted on driver's front trim panel (fig. 5). Reverse and starter relays are mounted on engine compartment control panel (fig. 4). Blower relay is mounted behind control panel at left of driver (fig. 7).

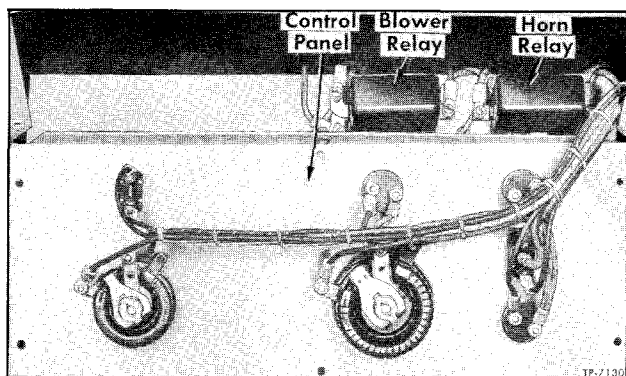


Figure 7—Driver's Control Panel Removed for Access to Relays

Relay used in these circuits is illustrated in figure 8. Relay points are normally open. When circuit is completed through relay winding, armature is attracted to core and points close. This completes circuit from "BAT" terminal through the points and the "VAC" terminal to the operating unit.

ADJUSTMENTS

Refer to "Specifications" at end of this group for air gap and point opening dimensions and for closing voltage.

Air Gap (Fig. 8)

Disconnect lead from "BAT" terminal. With contact points held closed, measure air gap between armature and center of coil. Adjust air gap by loosening two screws and moving armature up or down as required. If necessary, align the support carrying the lower contact so the air gap will be uniform between the coil and the armature.

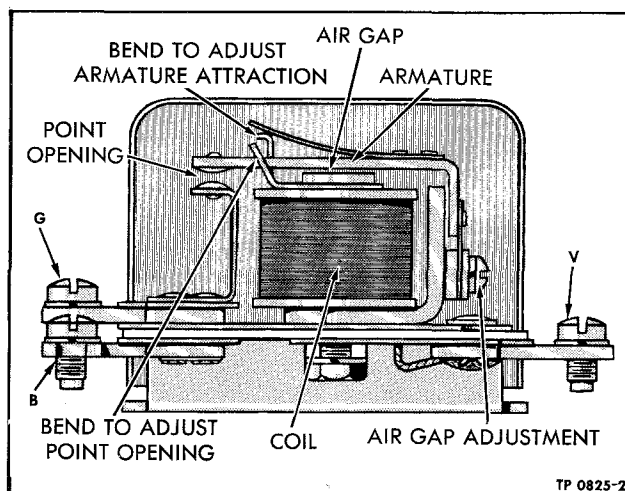


Figure 8—Relay Used in Lighting, Reverse, Starter, Blower, and Heater Circuits

WIRING AND MISC. ELEC.

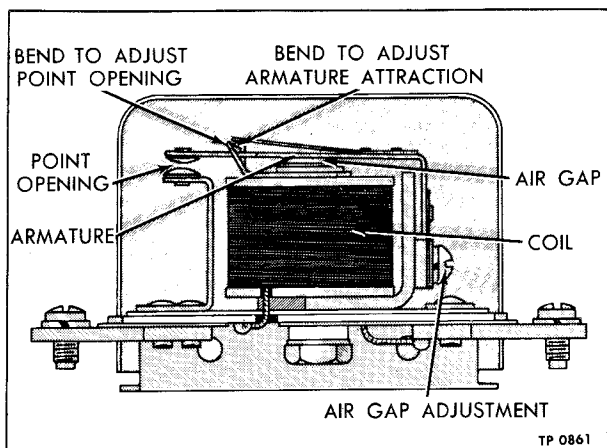


Figure 9—Horn Relay

Point Opening (Fig. 8)

Measure contact point opening with armature up against stop. Adjust point opening by bending armature stop.

Closing Voltage (Fig. 8)

With original leads connected to relay, connect an accurate reading voltmeter at the relay "VAC" and "GEN" terminals parallel with the relay operating circuit. Insert a variable resistance in series with the operating circuit at the "VAC" terminal. To check closing voltage, close relay operating switch, then adjust resistance until points close and note voltmeter reading. Adjust by bending armature spring post. Increasing spring tension increases closing voltage and decreasing tension decreases closing voltage.

HORN RELAY

Horn relay (fig. 9) is mounted behind control panel at left of driver (fig. 7). Coil windings of

relay are connected in series with the horn button. When horn button is pressed, circuit through relay winding is completed, and armature is attracted core. This completes circuit from "B" terminal through points and "D" terminal to horn.

ADJUSTMENTS

Refer to "Specifications" at end of this group for air gap and point opening dimensions and for closing voltage.

Air Gap (Fig. 9)

Disconnect lead from "B" terminal. Press armature down until points just touch and measure air gap between armature and core. To adjust, loosen two screws and raise or lower the armature as required. Make sure points are in alignment, then tighten screws.

Point Opening (Fig. 9)

With lead disconnected from "B" terminal, check point opening with armature up against stop. Adjust if necessary by bending armature stop.

Closing Voltage (Fig. 9)

Connect a voltmeter parallel with the operating circuit at the "B" and "S" terminals. Connect a variable resistance of 10 ohms in series with the operating circuit at the "B" terminal. With horn button pressed, slowly decrease resistance until points close and note voltmeter reading. Adjust if necessary by bending the armature spring post. Increasing spring tension increases closing voltage, and decreasing spring tension decreases closing voltage.

STOP LIGHT RELAY

Stop light relay (fig. 10) is mounted on engine compartment control panel (fig. 4). This is a two-unit relay, connected in series with the stop light switch, stop lights, and stop light tell-tale light. Refer to "Alarm and Signal Wiring Diagram" in back of manual for wiring connections. When brakes are applied, stop light switch contacts close, completing circuit from battery to stop lights through the relay coil windings. With coil windings energized, armatures are attracted to cores and points close. With points closed, circuit is completed to stop light tell-tale, indicating that stop lights are illuminated.

Both sets of contacts must be closed to complete circuit to tell-tale, and both bulbs in each stop light must be illuminated to provide sufficient current draw to close points. Thus, if one bulb in either stop light burns out, one set of points will not close and tell-tale will not illuminate, although the balance of the stop light bulbs will remain illuminated.

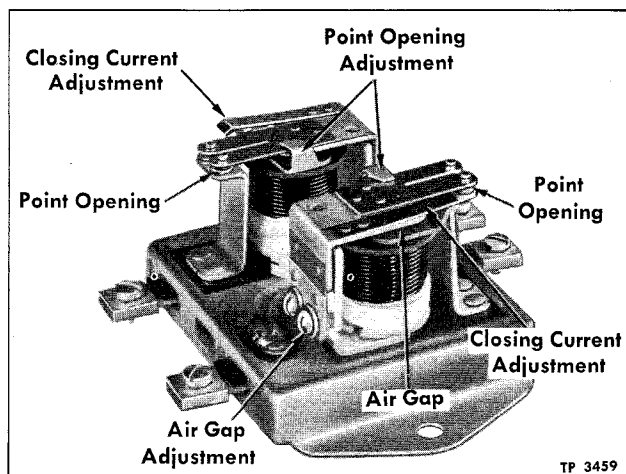


Figure 10—Stop Light Relay

WIRING AND MISC. ELEC.

ADJUSTMENTS

Refer to "Specifications" at end of this group for air gap and point opening dimensions and for closing amperage. The procedures which follow apply to both units.

Air Gap (Fig. 10)

Press armature down until points just close, then measure air gap between armature and center of core. Adjust air gap, if necessary, by loosening two screws and moving armature up or down as required. If necessary, align the support carrying the lower contacts so the air gap will be uniform between armature and entire top of core.

Point Opening (Fig. 10)

Measure contact point opening with armature up against stop. Adjust point opening by bending armature stop. Make sure opening at both points is equal and that both points close simultaneously when armature is depressed.

Closing Current (Fig. 10)

Connect an accurate ammeter and a variable resistance in series at the No. 4 terminal. Close stop light switch, then reduce resistance until points close and note ammeter reading when points close. Increase resistance until points open and note ammeter reading. If closing and opening amperage is not within limits listed in "Specifications," adjust by bending armature spring post to increase or decrease armature spring tension. Increasing tension increases closing amperage, and decreasing tension decreases amperage. Repeat this procedure with test equipment connected to No. 5 terminal to check other unit.

If relay does not function properly during normal operation in vehicle, candlepower of stop light bulbs should be checked. Stop light bulbs of proper size must be used or tell-tale light circuit will not function.

Circuit Continuity

Connect one prod of test lamp to No. 1 terminal and connect other prod to ground. With brakes applied (stop light switch closed), manually close both sets of relay points. If test lamp fails to light, relay circuit is open. Location of open circuit is located as follows.

Open Circuit

Connect one prod of test lamp to No. 5 terminal and other prod to ground. If test lamp fails to light when brakes are applied, relay coil is open circuited. Repeat procedure at No. 4 terminal to test other coil.

MOTO-GARD RELAY

Moto-Gard relay (fig. 11) is used in conjunction with Moto-Gard and air-operated injector shut-off system on some vehicles. Relay is mount-

ed on engine compartment control panel.

Relay points, which are normally closed, are connected in series with Diesel control switch and injector shut-off magnet valve. Relay coil winding is connected in series with the Moto-Gard unit contacts which are normally open. Refer to "Air Injector Shut-off and Moto-Gard Wiring Diagram" in back of manual. Operation of Moto-Gard system is previously explained under "Tell-tale Alarm System."

ADJUSTMENTS

Refer to "Specifications" at end of this group for air gap and point opening dimensions and for point opening voltage.

Air Gap (Fig. 11)

Depress armature against stop and measure air gap between armature and center of core. Adjust air gap, if necessary, by loosening two screws and moving armature up or down as required. If necessary, bend lower armature stop to obtain uniform gap between armature and core.

Point Opening (Fig. 11)

Measure point opening with armature depressed against lower stop. Adjust point opening, if necessary, by bending upper contact point support.

Opening Voltage (Fig. 11)

Connect an accurate reading voltmeter from "S" terminal to ground, and connect a variable resistance in series at the "S" terminal. Place engine control switch in "RUN" position, but do not start engine. Wait until low oil condition, due to engine not running, causes Moto-Gard points to close, then adjust resistance and note voltmeter reading at which relay points open and close. If not within limits listed in "Specifications," adjust by bending armature spring stop to increase or decrease armature spring tension. Increasing tension increases opening voltage, and decreasing tension decreases opening voltage.

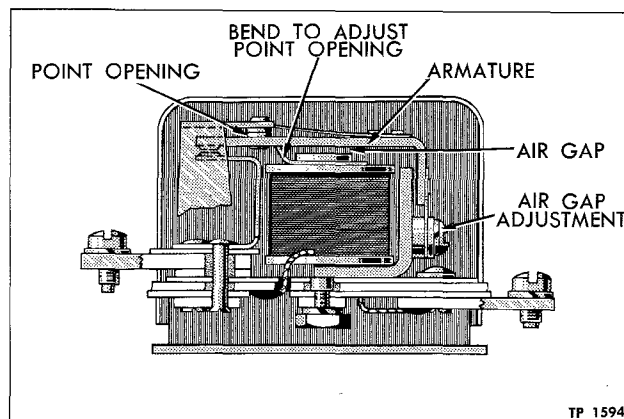


Figure 11—Moto-Gard Relay

WIRING AND MISC. ELEC.

SOLENOIDS AND MAGNET VALVE

A solenoid is an electrical device used to operate a unit to which it is mechanically connected. When solenoid coils are energized by completing electrical circuit through its controlling switch, solenoid plunger is pulled into coils, thereby operating the unit to which the solenoid plunger is attached.

ENGINE STOP SOLENOID

Engine stop solenoid is mounted on engine governor and is connected to governor cam. Solenoid, when energized by placing control switch in "STOP" position, moves governor cam, allowing governor to move injectors into no-fuel position. Refer to ENGINE (SEC. 8) for illustration showing solenoid installation.

EMERGENCY STOP SOLENOID

Emergency stop solenoid, mounted on blower intake, is used to release a valve to shut off air supply to engine, thereby stopping engine. Solenoid is energized through an "EMERGENCY STOP" switch on driver's control panel. When solenoid is energized, the solenoid plunger raises away from release cam on air choke valve, permitting the air choke valve to close.

NOTE: Whenever engine is stopped by releasing the air choke valve, valve must be reset by hand before engine can be started.

REVERSE SOLENOID

The reverse solenoid, mounted on transmission, is used to move shift finger into engagement with reverse shift fork so shift into reverse can be accomplished.

Reverse solenoid has two coils, the pulling coil and the holding coil. Electrical circuit to solenoid is controlled by a relay, mounted on engine compartment control panel, and a "REVERSE SELECTOR" switch on control panel at left of driver.

Refer to TRANSMISSION (SEC. 17) for illustration showing solenoid and linkage.

STARTER SOLENOID

Starter solenoid is mounted on starter and solenoid plunger is connected to starter shift lever

by a link (fig. 16). In addition to shifting starter pinion into engagement with flywheel ring gear, solenoid also completes circuit direct from battery to starter. Solenoid circuit is controlled by "START" switch on driver's control panel or on engine compartment panel, and a relay mounted on engine compartment panel. Refer to "Engine Control and Generator Wiring Diagram" in back of manual for starter circuit.

Solenoid has two coils. The pulling coil draws comparatively heavy current for a short interval. This is needed to shift pinion into engagement with flywheel ring gear. The holding coil also aids the pulling coil. As soon as the shift is completed and the solenoid contacts complete the starter circuit, the pulling coil is de-energized by action of the solenoid contacts and only the holding coil continues to draw current.

SOLENOID MAINTENANCE

Solenoids require no maintenance other than keeping contact points and terminals clean and tight. Always check action of solenoid if it has been removed and reinstalled. If solenoid fails to function, first check switches, relays, and wiring before working on solenoid. Solenoid current draw can be tested, using suitable test equipment. Correct current draw values for all solenoids are listed in "Specifications" at end of this group.

SOLENOID LINKAGE ADJUSTMENT

Refer to ENGINE (SEC. 8) for adjustment of engine stop and emergency stop solenoids. Refer to "STARTER" later in this group for starter solenoid linkage adjustment. Refer to TRANSMISSION (SEC. 17) for reverse solenoid linkage adjustment.

INJECTOR SHUT-OFF MAGNET VALVE

Magnet valve is used in conjunction with air-operated injector shut-off system to control the air pressure used for operation of the air cylinder. Wiring connections are shown on "Air Injector Shut-Off and Motor-Gard Wiring Diagram" in back of manual. Installation of magnet valve, together with a sectional view of the unit, are illustrated in DIESEL ENGINE (SEC. 8).

WIRING AND MISC. ELEC.

ELECTRIC HORN

Horn (fig. 12) operates on magnetic principle to produce warning signal. Current from battery flows through windings within horn when circuit is completed by action of a relay when horn button is pressed. Horn circuit is protected by No. 7 circuit breaker on panel at left of driver. Refer to "Alarm and Signal Wiring Diagram" in back of manual for horn circuit.

HORN TESTS

If horn produces a weak signal, voltage at horn should be checked by connecting a voltmeter across horn terminals. The voltage reading should not be less than 11 volts. A lower reading indicates either a low battery or a high resistance in horn circuit.

Loose or corroded connections in horn circuit should be corrected. Check for defective wiring by connecting separate test leads from horn to battery.

A loose connection or poor contact at horn push button may cause horn to operate intermittently. Shunt around horn button to determine whether there is poor contact at push button. Whenever wiring is replaced in horn circuit, use correct size as shown on wiring diagram.

Horns usually have a rasping sound when vital parts are broken or loose. A loose back shell may affect tone. Tighten collar screws, mounting nuts, and studs. Replace all damaged parts.

The horn will not function properly if field windings within horn are open circuited or grounded. Connect an ammeter in circuit at horn terminal. If there is no indication of current flowing when contact points are closed, windings are open circuited. The ammeter will indicate an excessive flow of current if windings are short circuited or grounded.

Windings may also be checked for grounded circuit with test lamp. Disconnect horn leads and touch one test point to one of horn terminals. If lamp lights, field windings are grounded.

Excessive arcing at contact points may be caused by improper current adjustment. An open

circuit in condenser will cause excessive arcing at points and, in some cases, contacts will be held together.

HORN ADJUSTMENTS

If tone is not satisfactory after checking preceding conditions, adjust horn in following manner:

1. Remove shell from horn.
2. Connect ammeter in circuit at horn and adjust current consumption by varying position of adjusting nut. Refer to "Specifications" at end of this group for current consumption.
3. Loosen adjusting lock nut and turn adjusting nut to left or right to increase or decrease current.
4. Too much current will cause horn to have a spluttering sound. This adjustment is very sensitive. Move nut 1/10 turn at a time and lock in position each time before trying. If ammeter is not available, adjust according to sound.
5. Correct air gap between armature and core is important for proper tone. The gap must be uniform across entire surface of armature. Width of gap may be determined by using a feeler. Adjustments are made by use of air gap adjusting nuts. Refer to "Specifications" at end of this group for correct adjustment dimensions.

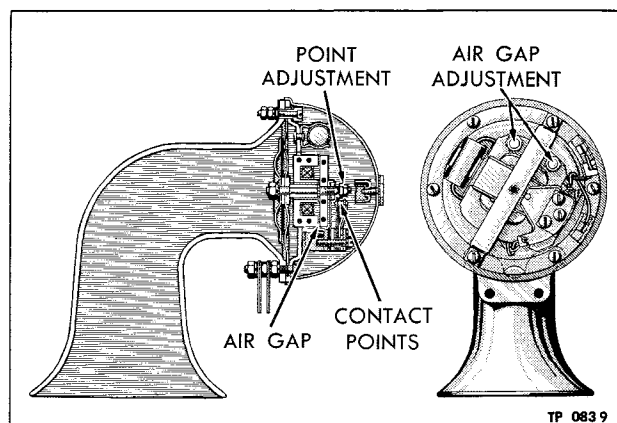


Figure 12—Electric Horn

ELECTRIC SPEEDOMETER

The electrical drive unit (fig. 13) is mounted in engine compartment and driven by a short flexible cable from the transmission speedometer drive gears. A four wire conductor cable plugged into drive unit is connected to an electric motor unit (fig. 14), mounted on back of mechanical speedometer head in instrument panel. Electric motor drives speedometer when actuated by electrical impulses from drive unit. Drive unit uses 12 volt current from battery or generator. A 6

amp. line fuse is installed in the drive unit feed line.

Electric speedometer wiring is shown on "Alarm and Signal Wiring Diagram" in back of manual.

Current is divided in drive unit by a mechanically driven rotor with two brushes which run against a resistor ring. Varying currents are transmitted to motor on speedometer head through a four wire cable.

WIRING AND MISC. ELEC.

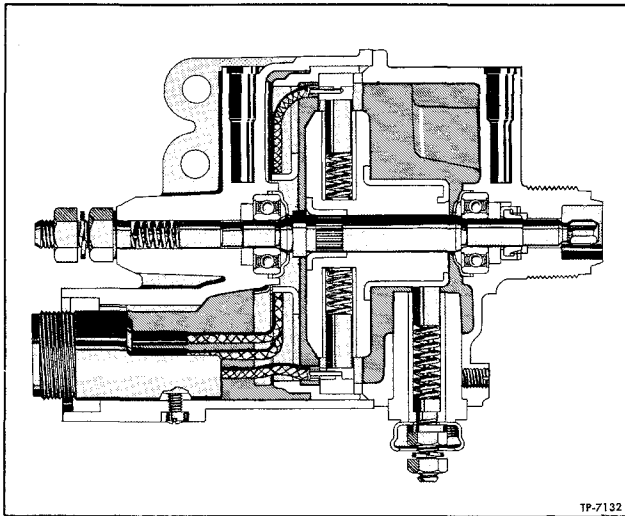


Figure 13—Electric Speedometer Drive Unit

Electrical currents from drive unit energize two pairs of coils in motor unit causing magnetic rotor to rotate at exactly same speed as mechanically driven unit. Since motor is coupled to speedometer head, rotation is transformed to a reading on face of calibrated speedometer head. Thus, a synchronized electrical drive supplants the standard drive cable.

TESTING

For testing speedometer electrical units (using battery of 12 volts), plus or minus one volt variation is permissible. The maximum current consumption should not exceed two amperes.

Jam nut, located at point four wire conduit fastens to connector plugs; should always be kept tight. The connector plug body grips cable insulation and prevents conduit coming loose from connector plugs due to rough handling which would cause loose connections.

A test light (1568147) should be used to test electric speedometer. If speedometer ceases to function proceed as follows:

1. Check test light bulbs with battery to be sure they are not burned out. Check 6 amp. fuse in feed wire to drive unit to be sure it is not burned out.
2. Pull four-contact plug out of top of drive unit and insert plug on end of light cable in its place.
3. Turn control switch to "RUN" position to energize drive unit.
4. Disconnect flexible drive shaft at transmission. Turn drive shaft slowly by hand. If lights alternately grow bright and dim, the drive unit is functioning properly.

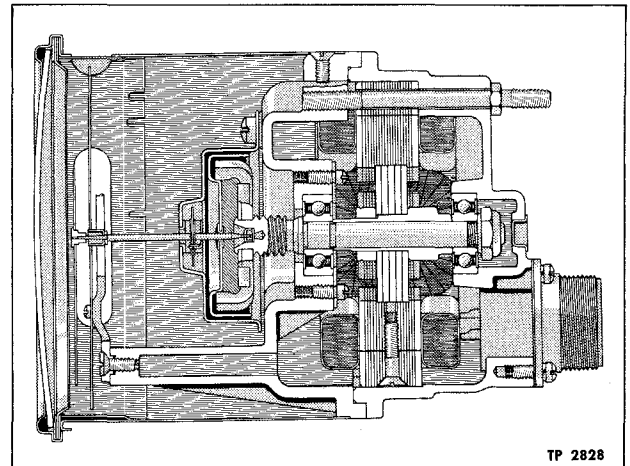


Figure 14—Electric Speedometer Motor Unit

5. Remove test light cable plug from drive unit and reconnect cable to drive unit.

6. Disconnect cable plug from speedometer head motor and connect to test light cable, using double end male adapter chained to end of cable.

7. Again turn drive shaft slowly by hand. If lights alternately go bright and dim, wiring between drive unit and head is good and trouble should be in head unit.

8. Always be sure that plugs make good contact when connected.

9. If lights fail to check when connected to unit, check feed and ground connections at drive unit for tightness; also for broken flexible drive shaft.

10. If lights check when connected to drive unit but not when connected at front of cable, careful check should be made of electrical cable for broken wire or loosen connections where wires attach to sockets.

With above procedure, it will be easy to determine whether trouble lies in drive unit, in connector plug and wiring, between drive unit and motor unit, or in motor unit and speedometer head assembly.

NOTE: If speedometer test fixture with master head is available, the speedometer can be tested with master speedometer reading 60 miles per hour. If speedometer calibration is not satisfactory when speedometer is driven mechanically, head may be recalibrated by an authorized United Motors Service Station. Speedometer calibration discrepancies have no connection with the electric drive unit, providing the speedometer head and motor unit are not binding, which is easily discovered by excessive pointer fluctuations.

Battery

Two batteries are mounted in battery compartment, located at rear of left rear wheelhouse. Compartment door is opened and closed with door lock wrench. Batteries are connected in parallel.

BATTERY MAINTENANCE

Batteries should be inspected and tested at least once a week. Inspection should include hold-down clamps, terminals, and electrolyte level. Each cell should be tested with a hydrometer. If terminals are corroded, remove cables and clean terminals and cable clamps with a solution of ammonia and water. Install cables, coat terminals and clamps with petroleum jelly, and tighten clamp bolts firmly. If ground strap or battery to starter cable are frayed or otherwise damaged, they must be replaced.

FILLING BATTERY

The battery cell covers are molded with a long, circular, tapered vent well which extends below the upper inside surface of the cover to a point even with the lower edge of the cover. A narrow vertical slot is molded in the sidewall of the vent well. Viewed from above through the vent opening, the lower end of the vent well presents the appearance of a ring with a portion of the circumference missing. The lower end of the vent well serves as the reference point in determining the proper level of the electrolyte. As water is added to the cell, the surface of the rising liquid contacts the slotted lower end of the vent well causing a distortion of the reflecting surface which is readily discernible. If some overfilling occurs, the amount can be estimated quickly by the height of the liquid in the vent well. In the same way, a glance will disclose whether or not a cell requires the addition of water after a period of service.

It should be kept in mind that the "visual level fill" cannot prevent overfilling, but is rather an aid to proper servicing. Overfilling should be avoided at all times since it contributes to premature battery failure by causing loss of electrolyte. Loss of electrolyte not only results in poor performance of the battery itself, but also causes excessive corrosion of the cables, connections, and battery hanger.

Add pure (preferably distilled) water to each cell as required to bring electrolyte to proper level as described above. In tropical climates, electrolyte level should be checked and adjusted daily. When temperature is below freezing, water should not be added unless vehicle is to be operated immediately. Water will not mix with the

electrolyte until engine is operated; unmixed water may freeze, causing damage to battery.

Freezing point of electrolyte depends upon its specific gravity. Following table gives freezing point for various specific gravities.

Specific Gravity	Freezing Point Degrees F.	Specific Gravity	Freezing Point Degrees F.
1.100	+18	1.220	-31
1.120	+13	1.240	-50
1.140	+ 8	1.260	-75
1.160	+ 1	1.280	-92
1.180	- 6	1.300	-95
1.200	-17		

TESTING BATTERY

Test each cell with an accurate hydrometer for specific gravity. The specific gravity indicates state of battery charge. The reading on a fully-charged battery should be between 1.275 and 1.290 at 80° F. When reading is below 1.225 battery should be recharged.

Battery may be tested with conventional testing instruments. These instruments, if used as manufacturer directs, will indicate condition of battery prior to recharging or repairing.

Battery should be recharged with standard equipment. Do not bring an open flame near battery during charging, as explosive gases form in cells during this operation.

Testing cell voltage in connection with specific gravity test will give a good indication of battery condition. Battery must test higher than 1.240 and battery, engine, and starter must be at normal room temperature, otherwise test will not be accurate.

Operate starter and quickly check each cell of battery with low reading voltmeter. To prevent engine starting, hold stop switch button in. If voltage reading is less than 1.7 volts at 80° F. or if there is a difference between cell readings of more than 0.1 volt, battery trouble is indicated and battery should be removed for further check.

BATTERY CABLES

Check cable leads and connections to determine if they are in good condition. Excessive resistance, generally caused by poor connections, produces abnormal voltage drop which may lower voltage at starting motor to such a low value that normal operation of starting motor will not be obtained. Abnormal voltage drop can be detected with a low reading voltmeter as follows:

STARTING SYSTEM

1. Check voltage drop between grounded battery terminal (positive) and vehicle frame. Place one prod of voltmeter on battery terminal and other on vehicle frame. With starting motor cranking engine at normal room temperature (70°F.) voltage reading should be less than 0.3 volt. If more than this, there is excessive resistance in this circuit.

2. Check voltage drop between ungrounded battery terminal (negative) and starting motor terminal stud while motor is operated. If reading is more than one volt, there is excessive resistance in circuit.

NOTE: If necessary to extend wire from meter for this test, use No. 16 or larger wire.

3. Check voltage drop between starting motor housing and vehicle frame. This must be less than 0.1 volt.

CAUTION: When working on engine, precautions should be taken to prevent accidental starting of engine. Make certain that starter circuit cut-out switch is "OPEN."

Starting System

Starting motor is identified by model number stamped on name plate attached to starter field frame. Starter solenoid and relay are identified by model number stamped on the unit base.

Starting system includes battery, starter, solenoid, solenoid relay, starter switches, starter cut-

out switch, circuit breaker, and wiring. Starting circuit is protected by Number 16 circuit breaker on panel at left of driver and by a circuit breaker on engine compartment panel. Starting system circuits are shown on "Engine Control and Generator Wiring Diagram" in back of manual.

OPERATION AND CONTROLS

The starting system operation is dependent upon the proper functioning of each unit included in the system.

Maintenance and adjustment of starter solenoid relay are covered under "Relays" in "WIRING AND MISCELLANEOUS ELECTRICAL" section at beginning of this group.

When starter button is pressed, an electrical circuit is completed through solenoid relay winding which closes relay points. When points are closed, circuit is completed through windings in solenoid. Solenoid then functions to move starter pinion into mesh with flywheel ring gear, at which time contacts in solenoid complete circuit direct from battery to starter.

Starter circuit is inoperative when cut-out switch on engine compartment panel is in "OPEN" position.

STARTER DRIVE OPERATION

Pinion is shifted into mesh with the flywheel teeth by the action of the solenoid plunger when starter button is pressed. Detailed action of the drive can be followed by referring to figure 15. Each illustration in figure 15 represents a position or step through which drive assembly passes in a complete cranking cycle. The drive housing, shift sleeve, and pinion are cut away showing action of parts. The engine flywheel is shown so the relative action of drive with flywheel can be noted.

At Rest Position (B, Fig. 15).

In the "At rest" position, pinion is held away from flywheel by locking action of pinion guide and pinion spring in milled portion of the shaft spline (F, fig. 15). The engine may or may not be in operation when drive is in this position. It is impossible for pinion to drift into flywheel when it is in this locked position.

Beginning of Engagement (C, Fig. 15).

The engine is dead and cranking operation has begun. As shift lever moves shift sleeve toward flywheel, pinion guide is unlocked from milled portion of spline by pressure of inner sleeve on guide. This action allows pinion to reach flywheel. Relative position of flywheel and pinion may be such that teeth will mesh immediately. If pinion teeth butt against flywheel teeth, pinion is further rotated until it reaches position for engagement. Compression of inner coil spring against pinion guide compensates for continued movement of shift lever and sleeve.

Engagement Action Complete (D, Fig. 15).

When pinion has been rotated to proper position for engagement, action is completed by further movement of shift lever and by the action of the pinion spring. Pinion stop limits travel of pinion. When meshing of pinion with flywheel is completed, further movement of the solenoid plunger closes the switch contacts, completing the starter circuit.

STARTING SYSTEM

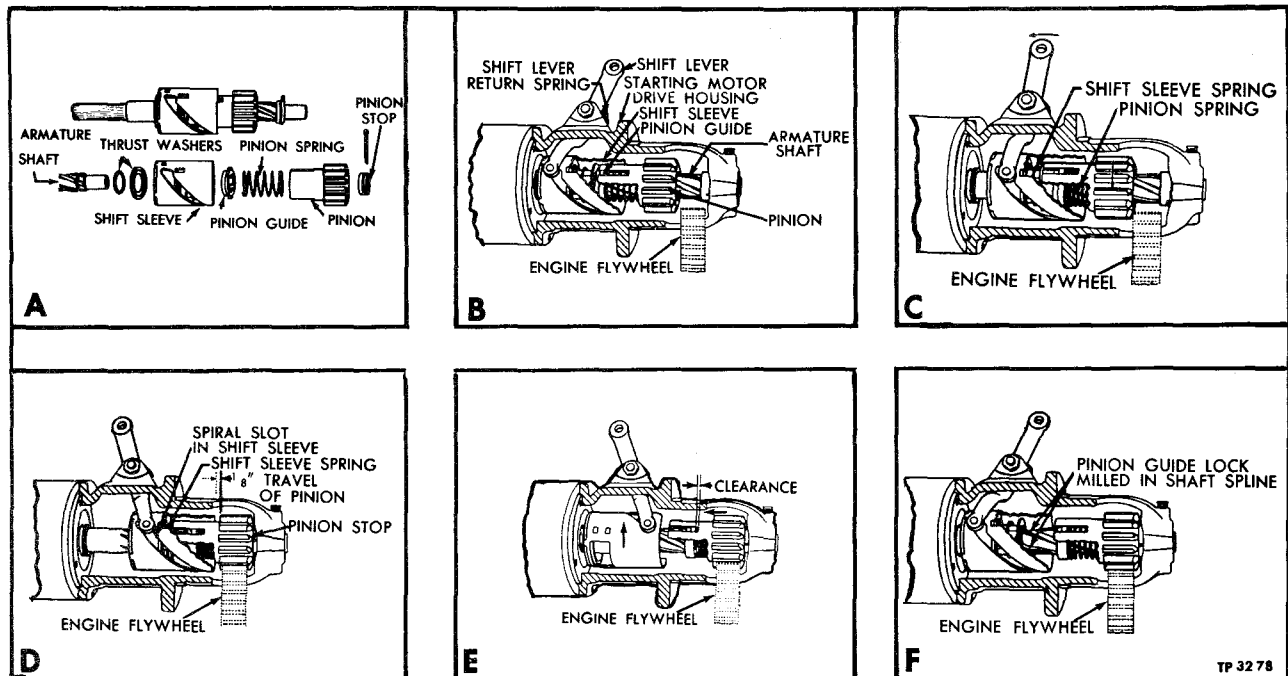


Figure 15—Dyer Drive Operating Positions

Operating Position (E, Fig. 15).

As starter begins to crank engine, shift sleeve is carried back to its original position by rotation of armature shaft. When engine fires, accelerating action disengages pinion from flywheel and pinion returns to locked or "at rest" position.

It is impossible to start another cranking operation until complete cranking cycle is finished. After engine fires, shift lever should be allowed to return to "at rest" position; unit is then ready for another cranking operation.

It is impossible to engage pinion while engine is running, for as soon as pinion teeth touch moving flywheel teeth, shift sleeve is rotated and pinion follows armature shaft spline back to locked position (F, fig. 15).

Relative Position of Parts (F, Fig. 15).

This illustration does not represent a step in cranking operation, but merely shows the position of the lock in shaft spline.

The engagement movement of shift lever is always against tension of shift lever return spring. When cranking operation is completed and shift lever returns, continued tension of shift lever return spring creates a force on armature assembly toward commutator end of starter. This force is transmitted through armature brake directly against brake washer in commutator end of starter. The force of armature brake against brake washer stops armature almost immediately after shift lever is allowed to return. This feature makes starter immediately ready for another cranking operation in case engine does not continue to operate after it fires.

STARTER

Starter, illustrated in figure 16, is solenoid operated "Dyer Drive" type. Solenoid, relay and shift mechanism operation are briefly described under "Operation and Controls" previously in this section.

INSPECTION AND MAINTENANCE
ON VEHICLE

Normal service may be obtained from starter with a minimum of trouble if regular lubrication, inspection, and maintenance procedures are followed.

CLEANING

Exterior as well as the interior of the starter should be kept clean. Use a clean cloth dampened with cleaning solvent to wipe off excess grease. Do not steam clean or dip starter, and avoid getting any water or cleaner in the starter. If interior of starter is dirty, remove, disassemble, and clean all parts individually.

COMMUTATOR

The cover band should be removed and commutator inspected at 5,000 mile intervals. If com-

STARTING SYSTEM

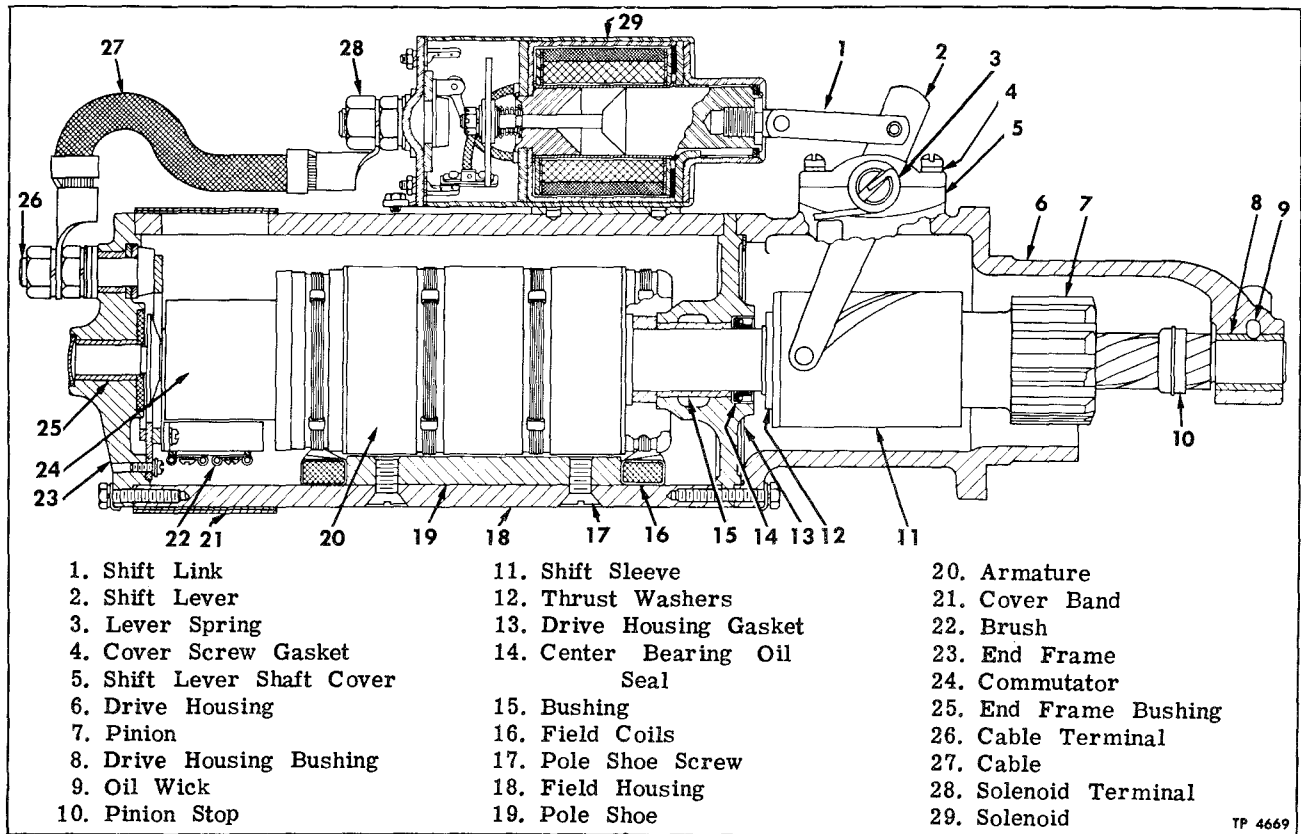


Figure 16—Sectional View of Starter and Solenoid

mutator is dirty, clean with strip of No. 00 sandpaper - DO NOT USE EMERY CLOTH. All dust must be blown from starter after commutator has been cleaned.

BRUSHES

Replace worn brushes. Brushes may be seated by use of a brush seating hone. With starter operating at medium speed, press hone firmly against commutator to cover area contacted by brushes. Brushes should seat satisfactorily in a short period. Blow starter out with compressed air after using hone to remove all particles of abrasive. Do not use emery cloth or sandpaper to seat brushes. Check brush lead connections to be sure they are tight.

Brush Spring Tension

Check brush spring tension. Excessive spring tension will cause commutator and brushes to wear rapidly. Low spring tension will cause a reduced starter speed, also arcing and burning of commutator and brushes. Replace springs if tension is not as listed in "Specifications" at end of this group.

MISCELLANEOUS

Make careful inspection of wires, terminals, and all visible parts of starter. Any apparent de-

fects should be corrected immediately.

Unusual noises in the starter may be caused by loose mountings. Worn or dirty bushings may cause noise or slow starter speeds and require cleaning and lubrication or, if worn excessively, replacement. Improperly seating brushes may cause slow starter speeds. Brushes can be re-seated as previously explained under "Brushes." Bent brush holders should be replaced.

STARTER REMOVAL

1. Remove battery cable from solenoid "Bat" terminal and tape end to prevent accidental short and discharge of battery, or preferably disconnect ground cable at battery.

2. Remove three stud nuts attaching starter to flywheel housing. Move starter straight away from housing to complete removal.

STARTER DISASSEMBLY

(Refer to Figure 16)

1. Remove cable connecting solenoid terminal to terminal at starter commutator end frame. Disconnect solenoid plunger link from shift lever. Remove solenoid assembly from starter field frame.

STARTING SYSTEM

2. Mark commutator end frame, field frame, center bearing plate, and drive housing to facilitate reassembling in correct position.
3. Remove cover band and disconnect the two field winding leads from brush holders.
4. Remove cap screws and lock clips attaching commutator end frame to field frame. Remove commutator end frame assembly.
5. Remove cap screws and lock clips attaching drive housing to field frame. Remove field frame from armature and drive housing.
6. Remove shift lever cover attaching screws. Remove cover, shift lever assembly, and shift lever spring. Remove drive housing from armature shaft.
7. Remove cotter pin attaching pinion stop to armature shaft, then remove stop. Remove Dyer Drive assembly from armature shaft, noting position of parts to aid in reassembly. Remove two washers, center bearing plate, and collar from armature shaft.

INSPECTION, TESTS, AND REPAIR

Wash all parts except field frame and field coil assembly, armature, and overrunning clutch in cleaning solvent. Armature, clutch, and field coils should be wiped clean with a dry rag. Tests described below may be made on a conventional growler equipped with test lamp and prods.

ARMATURE

Check armature to commutator leads to make sure they are properly soldered. Place one prod of test lamp on armature and other on commutator. If test lamp lights, armature is grounded and should be replaced if defect is not readily apparent and repairable.

Place armature on growler. Hold hacksaw blade over armature and slowly rotate armature. If saw blade vibrates, armature is short circuited. Before replacing, inspect commutator slots for copper or brush dust deposits. Clean thoroughly and retest.

Bruned commutator riser bars are sometimes caused by an open-circuited armature. If bars are not too badly burned, armature can sometimes be repaired by resoldering the leads in riser bar, using rosin flux solder. After soldering, turn down commutator and undercut the mica.

COMMUTATOR

Inspect commutator and if found to be rough, out-of-round, worn or has high mica, filled slots, or is burned, repair as follows:

Turning Down

Place armature in lathe and turn down commutator to remove worn spots, out-of-round, or

rough condition. Do not cut deeper than necessary to clean up.

Undercut Mica

Mica between commutator segments must be below edges of segments. Start groove with a small three-cornered file; then use a hacksaw blade to undercut mica to a depth of 1/32". Use No. 00 sandpaper to clean and smooth up commutator, then blow all dust and cuttings out of grooves.

FIELD COILS

Place one test prod on field frame and touch other prod to each of the field coil leads which connect to the brush holder. The test lamp should light when each circuit is completed. If lamp does not light, field circuit is open. Inspect connections between coils.

Disconnect field coil leads from field frame at drive end. Pry leads away from frame to eliminate electrical contact. Place one test prod on field frame and other on each of the exposed leads. Lamp should not light. If lamp does light, field coils are grounded and must be replaced.

COMMUTATOR END FRAME

Remove all brushes. Place one test prod on end frame and other on brush holder and on terminal stud. Test lamp should not light. If test lamp does light, it is an indication of defective brush holder insulation or terminal insulators. Replace defective insulation under brush holders or at terminal.

If brushes are worn down to less than one-half their original length, they must be replaced. Be sure leads are secure in brushes and that clips are properly soldered to leads.

Check brush spring tension. If not within limits listed in "Specifications" at end of this group, replace with new springs. Examine hinge pins and brush holders for bent or damaged condition. Any condition which might prohibit free brush action must be corrected.

Replace end frame bushing if worn excessively or out-of-round.

DRIVE HOUSING

Replace bushing in drive housing if worn excessively or out-of-round. Also replace oil wick at bushing.

CENTER BEARING

If bushing in center bearing plate is worn excessively or out-of-round, replace. Also replace oil wick in center bearing plate.

DYER DRIVE

Carefully inspect all parts of Dyer Drive for wear or other damage. Check spring for weak or

STARTING SYSTEM

broken coils. Inspect pinion for worn or chipped teeth or splines.

STARTER ASSEMBLY

1. Install commutator end frame on field frame, aligning marks made prior to disassembly. Attach with cap screws and lock clips.

2. Insert armature into field frame, with end of shaft inserted in bushing in end frame.

3. Place collar and center bearing plate over drive end of armature shaft and position center bearing plate against field frame, aligning marks made prior to disassembly.

4. Place plain washer and cupped washer over armature shaft, with cupped side of washer toward armature shaft. Assemble shift sleeve, pinion guide, and spring on armature shaft, with lugs on pinion guide toward end of shaft. Do not twist the pinion guide onto shaft more than about 1-3/4" from end of shaft. Hold guide in this position and place pinion on shaft over spring, compressing spring into pinion skirt. Align lugs on pinion guide with slots in pinion skirt. Hold pinion guide stationary with thumb and forefinger while pushing pinion onto shaft so lugs on guide enter slots in pinion skirt. Remove thumb and forefinger and twist the assembly back onto the armature shaft and into the shift sleeve. As it reaches the extreme position, a click will be heard which indicates that the pinion guide has dropped into the undercut section of the shaft splines so the assembly is locked in the "at rest" position.

5. Install pinion stop by aligning it with the spline grooves and turning it on until it hits the undercut. It can then be rotated to align the holes in the shaft and pinion stop. Install new cotter pin to hold pinion stop in place.

6. Install drive housing over drive assembly and armature shaft and position against center bearing plate. Attach drive housing and center bearing plate to field frame with cap screws and lock clips.

7. Assemble shift lever and cover to drive housing, being sure end of lever is in the spiral slot in shift sleeve. Attach cover to drive housing with screws and lock washers and tighten firmly. Check action of lever. If any binding is evident, it can be corrected by tapping cover with soft hammer to align it with shaft and housing. Place shift lever spring on lever shaft with long tang on boss on drive housing. Twist coiled end of spring and drop into slot in end of shaft.

8. Install solenoid on field frame and connect plunger link to shift lever. Install cable connecting solenoid terminal to terminal on commutator end frame.

9. Adjust linkage between solenoid and shift lever as directed below.

SOLENOID AND DRIVE ADJUSTMENT

When shift lever is in extreme forward position and switch contacts in solenoid are closed, it should be possible to push the pinion back against spring pressure 1/8" to 3/16" (D, fig. 15). This adjustment can be checked easily by disconnecting cable from solenoid to starter terminal and using battery current through solenoid to hold shift lever in forward position. Since disconnecting this cable opens pull-in coil circuit of the solenoid, it may be necessary to assist movement of plunger by hand to assure that plunger will reach its extreme travel position, closing switch contacts. The starter armature will not revolve with this cable disconnected. The pinion travel can be checked by pushing pinion back against spring pressure. The adjustment can be changed by turning plunger stud in or out of solenoid as necessary.

A test can be made to determine if engagement action is being completed before switch contacts are closed. This can be done by placing a 9/16" spacer between pinion and pinion stop. The shift lever can then be moved forward, forcing pinion against spacer. It should not be possible to close switch contacts with spacer in place. This adjustment can be changed by adjusting plunger stud as mentioned above.

When pinion is in engaged position (E, fig. 15), there should be 1/32" clearance between pinion guide lug and bottom of slot in pinion skirt. If there is no clearance at this point, drive will be taken directly from lugs on pinion guide rather than from the heavy spline in the pinion. If there is no clearance at this point, pinion and pinion guide should be replaced. The pinion, with its lock and lock spring, is released by moving pinion shift sleeve forward along shaft splines.

When assembling drive parts, pinion guide lugs must be toward the pinion or it will not be in the proper position to lock on the shaft.

If testing equipment is available, No-Load and Torque tests may be made to determine if starter operates properly. Data necessary for these tests is listed under "Specifications" at end of this group.

INSTALLATION

1. Locate starter in position against flywheel housing. Install three stud nuts, using lock washers. Tighten cap screws or nuts evenly and alternately until tight.

2. Attach battery and solenoid cables to starter solenoid, then tighten terminal nuts.

Generator

Generator (fig. 18) is a heavy duty, six-brush, shunt type unit. The armature shaft is supported by a roller bearing in the drive end frame and by a ball bearing with a grease seal in the commutator end frame. Brush holders are of one-piece construction and are mounted on the commutator end frame. Insulated holders are electrically insulated from the commutator end frame by bakelite pads. Each brush holder is held in position by two countersunk screws extending through the commutator end frame. Special two-piece brushes of laminated construction are used.

Air entering generator must pass through an oil-wetted air strainer which is mounted on commutator end frame. Air passes through generator and is discharged through an opening in the drive end frame into a tube leading to engine air cleaner manifold. Refer to FUEL SYSTEM (SEC. 12) for illustration of air outlet tube installation.

Generator is mounted on engine flywheel housing and is driven from the engine balance shaft through a step-up gear arrangement (fig. 17).

INSPECTION AND MAINTENANCE

Normal service may be obtained from generator with a minimum of trouble if regular inspection and maintenance procedures are followed.

LUBRICATION

Roller bearing at drive end and ball bearing at commutator end are lubricated through grease cups. Refer to LUBRICATION (SEC. 13) for type of lubricant and intervals of application. Air strainer at commutator end must be cleaned regularly.

CLEANING

Exterior as well as interior of the generator assembly should be kept clean. Use a clean cloth dampened with cleaning solvent to wipe off excess grease. Do not steam clean or dip generator into a cleaning solvent. Avoid getting any water or cleaning solvent in generator. If interior is dirty, remove and disassemble generator and clean individual parts. Use only cleaning solvents derived from petroleum such as kerosene or gasoline. Never use chemical solvents or alkalines since these may damage the insulation.

COMMUTATOR

The cover band should be removed and commutator inspected at 5,000 mile intervals. If commutator is dirty, clean with a strip of No. 00 sandpaper. No not use emery cloth. Blow all dust out of generator after cleaning commutator.

BRUSHES

Check the surface of the brushes making contact with commutator to make sure they are seating properly. They can be seated with a brush seating hone. Do not use emery cloth or sandpaper for seating brushes. With generator operating at medium speed, press seating hone firmly against commutator to cover area contacted by brushes. Brushes should seat satisfactorily in a short period. Blow out all particles of abrasive and dust after seating. Worn brushes should be replaced and new brushes seated.

NOTE: When new brushes have been installed, it is necessary to adjust generator neutral point as directed later under "Generator Assembly."

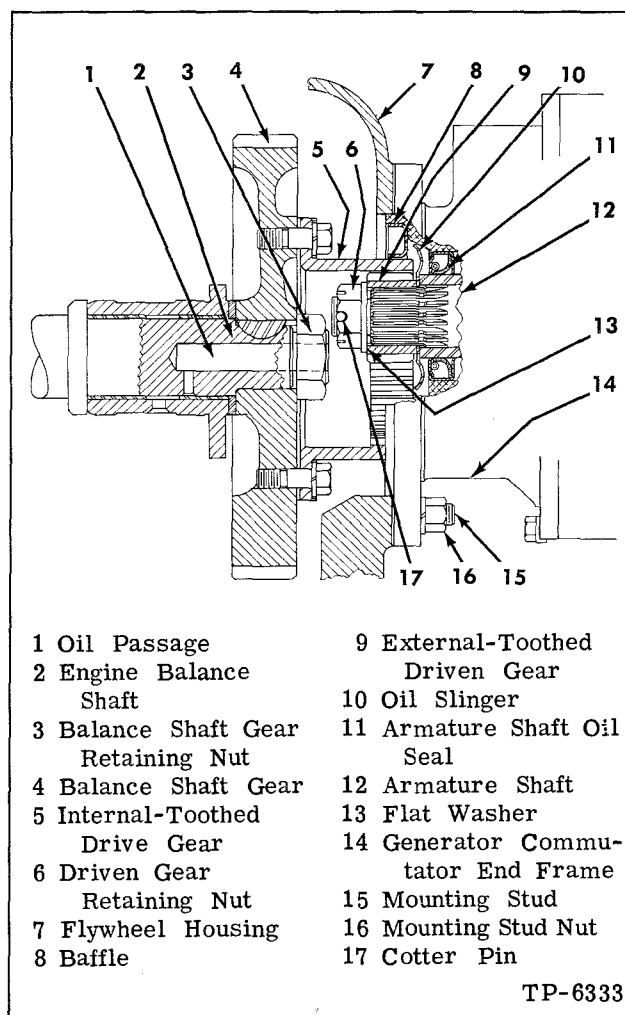


Figure 17—Generator Step-up Drive Arrangement

GENERATOR

Brush Spring Tension

Check brush spring tension. Replace springs if tension is not as listed in "Specifications" at end of this group. Excessive spring tension will result in reduced generator output, also arcing and burning of commutator and brushes.

MISCELLANEOUS

Make careful inspection of wires, terminals, and all visible parts of generator. Any apparent defects should be corrected immediately. A poor connection in charging circuit will cause generator to build up excessive voltage which may result in burned field or armature windings. A poor connection in generator field circuit will cause low output.

Noise in generator may be caused by loose mounting, worn drive gears, worn or dirty bearings. Dirty bearings should be cleaned and lubricated. Worn bearings or drive gears should be replaced. Improperly seating brushes or bent brush holders may also cause noise. Seat brushes or replace holders as necessary.

GENERATOR REPLACEMENT

REMOVAL

1. Disconnect wires from three terminals at generator, tagging each wire for identification at time of installation.
2. Disconnect generator air outlet tube from generator air outlet fitting.
3. Remove nuts and lock washers from five studs attaching generator to flywheel housing. Pull generator straight back off mounting studs to complete removal.

INSTALLATION

1. Install new gasket on generator mounting studs. Position generator on mounting studs, making sure external teeth on armature shaft gear mesh with internal teeth in drive gear. Install lock washers and nuts on studs and tighten firmly.
2. Install wires on three generator terminals according to identification made at time of removal. Install lock washers and nuts on terminal studs and tighten firmly.
3. Connect generator air outlet tube to air outlet fitting. Tighten hose clamps firmly.
4. **IMPORTANT:** Before starting the engine, polarize generator as directed under "Polarity" in "REGULATOR" section.

TESTING GENERATOR

Several conditions may require removal of generator from engine for further checking as follows:

NO OUTPUT

Remove cover band and check for sticking or worn brushes and burned commutator bars. Burned bars, with other bars fairly clean, indicate open circuited coils. If brushes are making good contact with commutator, and commutator looks satisfactory, use test leads and lamp and check as follows:

1. Test for grounded armature. Raise grounded brushes and insulate from commutator. Check with test leads from "A" terminal to generator field frame. Lamp should not light. If lamp does light, raise other brushes and check commutator and "A" terminal separately to locate ground.
2. Check field for open circuit by checking with test points from "F" terminal to frame. Lamp should light.
3. If field is not open, check for shorted or grounded field by measuring field current draw. Excessive current draw indicates shorted or grounded field. Check field current draw by applying exactly 12 volts across field at 80°F., and measuring current flow with suitable ammeter. Current draw should not exceed 6.0-6.85 amperes. If field is grounded or shorted, it will be necessary to disassemble generator to locate the trouble.
4. If trouble has not been located in the above checks, remove armature and check on growler for short circuit.

UNSTEADY OR LOW OUTPUT

1. Check drive gears for broken teeth.
2. Check brush spring tension and check for sticking brushes. Replace weak brush springs and free up sticking brushes.
3. Inspect commutator for roughness, grease and dirt, dirt in slots, high mica, out-of-round, or burned bars. If any of these conditions are evident, commutator must be turned down in a lathe and the mica undercut. Commutator must not be more than .001" out-of-round after turning down. With burned bars, which indicate an open circuit, the open circuit condition must be corrected if possible or the armature replaced.

EXCESSIVE OUTPUT

If regulator is known to be operating satisfactorily, excessive output may result from a shorted generator field. This can be checked as directed in step 3 under "No Output."

GENERATOR DISASSEMBLY

(Refer to Figure 18)

1. Remove four thumb nuts attaching air strainer cover to bearing end plate and remove cover and air strainer. Remove cover band from commutator end frame. Disconnect brush leads, and disconnect lead from insulated brush holder connector.

GENERATOR

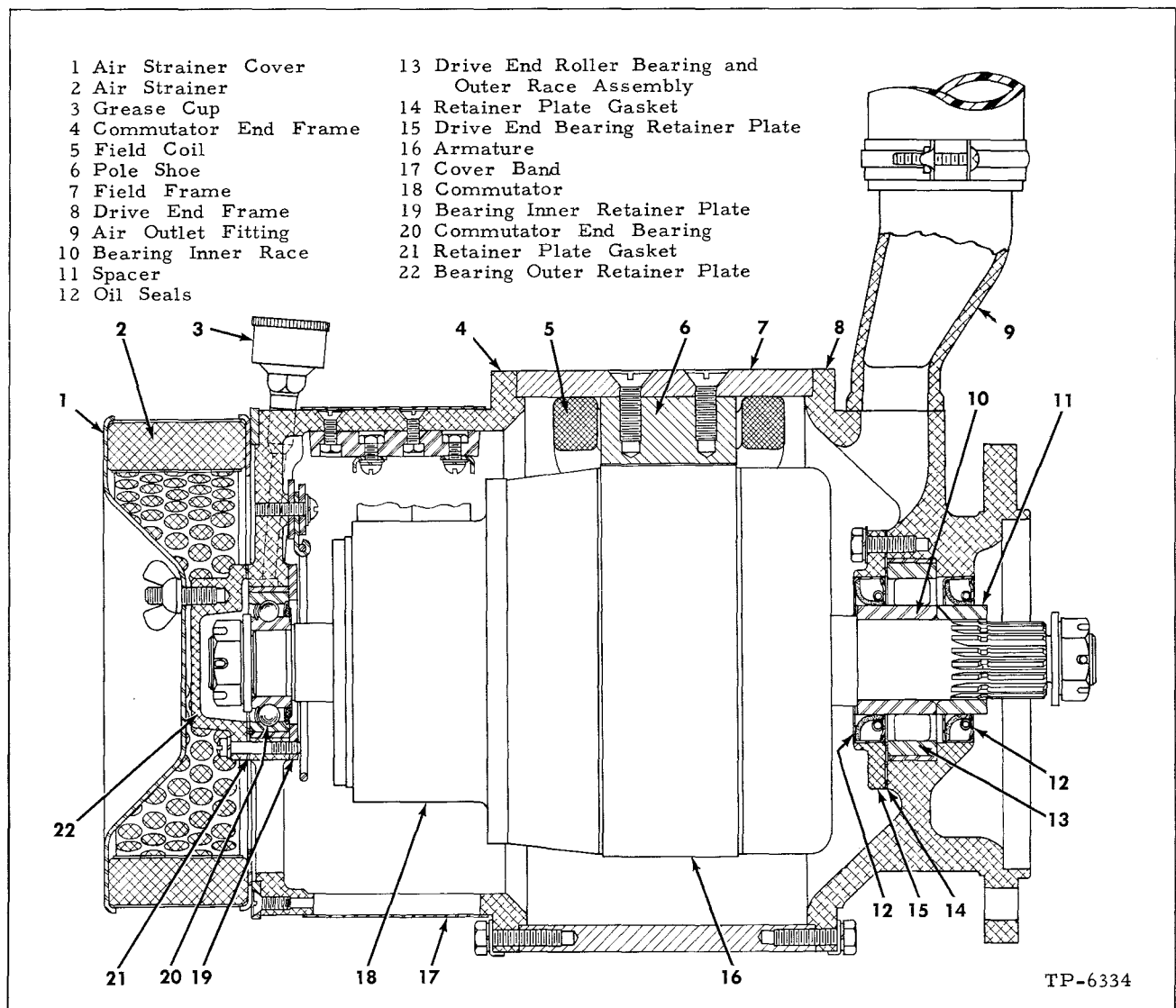


Figure 18—Sectional View of Generator

2. Remove screws and lock washers attaching bearing outer and inner retainer plates to commutator end frame. Remove cotter pin, nut, and washer from commutator end of armature shaft.

3. Remove cap screws, washers, and lock clips attaching commutator end frame to field frame. If necessary, tap end frame with soft hammer to loosen, then remove end frame assembly. Remove ball bearing from end frame. Remove brushes from brush holders.

4. Remove cap screws, washers, and lock clips attaching drive end frame to field frame. If necessary, tap end frame with soft hammer to loosen, then remove end frame and armature.

5. Clamp armature in vise, then remove nut and washer from drive end of armature shaft. Remove baffle, drive gear, and oil slinger, then lift

end frame assembly from armature shaft.

6. Remove cap screws and lock washers attaching bearing retainer plate to drive end frame; then remove retainer plate and seal assembly. Remove roller bearing and outer race assembly from drive end frame.

7. It is not necessary to remove pole shoes and field coils from field frame except as indicated later under "Inspection, Tests, and Repair."

INSPECTION, TESTS, AND REPAIR

All parts except field coils and armature should be washed in cleaning solvent. Field coils and armature should be wiped clean with a dry rag. Tests described below may be made on a conventional growler equipped with a test lamp and prods.

GENERATOR

ARMATURE

Check armature to commutator leads to make sure they are properly soldered. Place one test lamp prod on armature and other on commutator. If lamp lights, armature is grounded and should be replaced if defect is not readily apparent and repairable.

Place armature on growler. Hold hacksaw blade over armature and slowly rotate armature. If saw blade vibrates, armature is short circuited. Before replacing, inspect commutator slots for copper or brush dust deposits. Clean slots thoroughly and retest.

Burned commutator riser bars are sometimes caused by an open-circuited armature. If bars are not too badly burned, armature can sometimes be repaired by resoldering the leads to the riser bars, using rosin flux solder. After soldering, turn down the commutator and undercut the mica as directed under "Commutator."

Inspect drive end bearing inner races on drive end of armature shaft. If excessive wear is evident, pull races off shaft and press new races into place.

COMMUTATOR

Inspect commutator and if found to be rough, out-of-round, worn or has high mica, filled slots, or burned, repair as directed below.

Turning Down. Place armature in lathe and turn down commutator to remove worn spots, out-of-round, or rough condition. Do not cut deeper than necessary to clean up. Commutator must not be more than .001" out-of-round after turning down.

Undercut Mica. Mica between commutator segments must be below edges of segments. Start groove with a small three-cornered file; then use hacksaw blade to undercut mica to a depth of 1/32". Use No. 00 sandpaper to clean and smooth up commutator; then blow out all particles of dust and cuttings.

FIELD COILS

These tests must be made with field coils installed in field frame.

1. Place one test prod on "F" terminal and other on field frame. Lamp should light; if lamp does not light, field coils are open circuited.

2. Disconnect field coil lead from field frame. Place one test prod on "F" terminal and other on field frame. Lamp should not light; if lamp does light, field coils are grounded.

3. If field coil current draw was excessive as indicated under "No Output" in "Testing Generator," determine which coil is shorted as follows: Remove insulation from soldered connections between coils, then check current draw of each coil separately. The coil which draws the most current is shorted and must be replaced.

4. If ground or open circuit is indicated in tests 1 and 2, break the connections between the coils and test each coil separately to determine which one is defective.

5. If field coil insulation is cracked, charred, or worn so that windings are exposed, coils should be reinsulated or replaced. Connect and reinsulate any field coil connections which have been broken or bared during tests.

BRUSHES, BRUSH HOLDERS, AND SPRINGS

1. Check insulated brush holders by placing one test prod on insulated brush holder connector and other on end frame. Lamp should not light; if lamp lights, remove brush holder connector and test each insulated brush holder separately to determine which one is grounded. Replace insulating washers on any insulated brush holders found to be grounded.

2. If brushes are worn down to less than one-half their original length, they must be replaced. Make sure leads are secure in brushes and that clips are properly soldered to leads.

3. Check brush spring tension. Replace springs if tension is lower than listed in "Specifications" at end of this group. Examine brush holders for bent or damaged condition. Any condition which might prohibit free brush action must be corrected.

BEARINGS

Thoroughly clean bearings and inspect for worn or damaged balls, rollers, or races. Pack bearings with grease recommended in LUBRICATION (SEC. 13).

OIL SEALS

Examine lips of drive end frame oil seals for wear or deterioration. Replace seals if not in good condition.

GENERATOR ASSEMBLY

(Refer to Figure 18)

1. Install oil seal in drive end frame and in drive end bearing retainer plate. Install drive end bearing outer race and roller assembly in drive end frame. Install ball bearing assembly in commutator end frame. If any brush holders were removed, install in end frame, making sure insulator washers and bushings are in place on insulated holders.

2. Position drive end bearing retainer and seal assembly on inner side of drive end frame, using new gasket between retainer and end frame. Attach retainer to end frame with six screws, using flat washer and lock washer under head of each screw.

3. Clamp armature in vise, drive end up.

GENERATOR

Make sure bearing inner races are in place on drive end of armature shaft; then install drive end frame assembly over shaft and races. Install oil slinger and external toothed gear on armature shaft and secure with washer and nut. Tighten nut to 180 foot-pounds torque. Install baffle in counterbore in drive end frame. Remove armature and drive end frame assembly from vise.

4. Mount field frame assembly in vise. Do not tighten vise jaws sufficiently to distort frame. Insert armature into field frame and position drive end frame against field frame. Attach end frame to field frame with ten cap screws, using lock clip and washer under each cap screw head.

5. Slide ball bearing retainer plate over commutator end of armature shaft. Install commutator end frame assembly over armature shaft and position against field frame. Attach end frame to field frame with six cap screws, using lock clip and washer under each cap screw head. Tighten screws only finger tight.

6. Install washer, nut, and cotter pin on commutator end of armature shaft. Position commutator end bearing outer retainer plate on end frame, with new gasket between plate and end frame. Insert screws through retainer plate and end frame, then reach through openings in end frame to position bearing inner retainer plate so screws can be threaded into tapped holes in plate. Tighten screws firmly.

7. Install brushes in holders and connect brush leads, making sure connections are tight. Connect lead from "A" terminal to insulated brush holder connector.

8. Install air strainer and cover on commutator end frame and attach with four thumb nuts.

9. Before installing generator on vehicle, adjust neutral point as described below; then test as previously directed.

NEUTRAL POINT ADJUSTMENT

Whenever generator has been disassembled, new brushes, armature, or field coils installed, the neutral point must be adjusted. The neutral point refers to a particular relationship between the field poles, armature windings, and brushes. When the relationship of these parts is correct, minimum arcing and best commutation and brush life will be obtained. All brushes must be properly seated with a brush seating hone before adjusting neutral point.

CAUTION: Adjustment for neutral point must be made as quickly as possible since armature will begin to heat. Do not allow armature to overheat. Adjust as follows:

1. With generator assembled and commutator end frame attaching screws just tight enough to hold end frame in place, place generator on test bench with armature free to rotate, and without any connection to generator field (F) terminal.

2. Connect a battery between generator armature (A) terminal and ground, and allow a current of approximately 100 amperes to flow through armature. (Current may be controlled by variable resistance or by varying the number of battery cells used.)

3. Note tendency of armature to rotate. The neutral point is found by shifting (rotating) commutator end frame into the position at which there is no tendency for the armature to turn in either direction. After this position has been found, advance brushes $1/2$ to $3/4$ the width of a commutator bar, by rotating commutator end frame in the direction of normal armature rotation. Tighten commutator end frame attaching cap screws firmly and secure with lock clips.

Regulator

The regulator shown in figure 19 is a heavy-duty carbon pile regulator developed especially for use with light weight, high output generators. Although similar in external appearance to other heavy-duty regulators of the vibrating-contact type, the carbon pile regulator functions on an entirely different principle which must be clearly understood before adjustments of the regulator are attempted. Both types of regulators serve the same purpose, namely, to limit voltage and current to the required operating values, and to disconnect the generator from the battery when the generator is not capable of supplying power to the system, but the methods of control are basically different.

CONSTRUCTION

In the carbon pile regulator, the field current is controlled by a carbon pile rheostat inserted in the field circuit. The field circuit is not interrupted, and any amount of field current can be handled provided the unit is made large enough and has sufficient heat-dissipating capacity. To dissipate the heat generated in the rheostat by its continuous operation, the aluminum castings of the current and voltage regulators, which hold the carbon disks, are attached directly to a radiator which carries the heat outside the box.

The carbon pile rheostat itself consists of a stack or pile of small flat carbon disks inside a ceramic tube. Resistance of the stack varies with the amount of pressure on the disks, decreasing as the pressure is increased. The carbon disks must be absolutely flat and free from any foreign

material, especially grease and dirt. This is necessary to reduce the change in length of the carbon pile in relation to the required changes in pressure. Throughout the working range of the regulator the change in length of the carbon pile does not exceed .003 inch.

VOLTAGE AND CURRENT REGULATORS

In order to control the generator, the resistance of the rheostat must be made to vary with every change in load or speed. This is accomplished by the current and voltage regulators in which the carbon disks are compressed by a spring and the spring opposed by an electromagnet. The electromagnet in the voltage regulator (fig. 19) is wound with many turns of fine wire and is connected in shunt across the generator as shown in figure 20. In the current regulator (fig. 19), the electromagnet is wound with a few turns of heavy wire and connected in series with the generator output (fig. 20). When the voltage or the current tends to exceed the adjusted value, the increased pull of the electromagnet reduces the pressure on the disks, thus increasing their

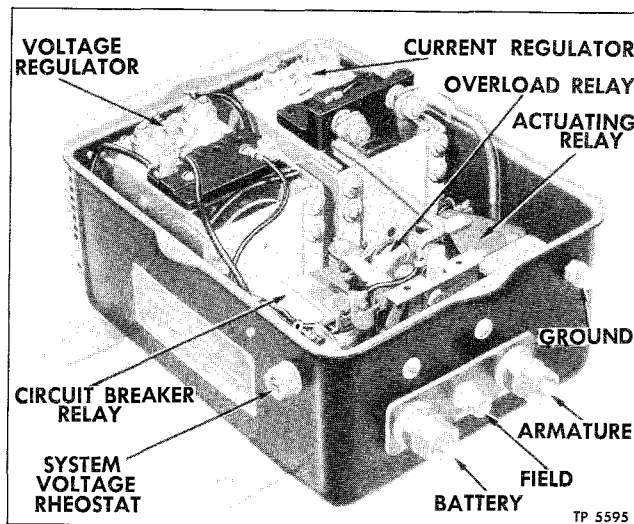


Figure 19—Carbon Pile Regulator with Cover Removed

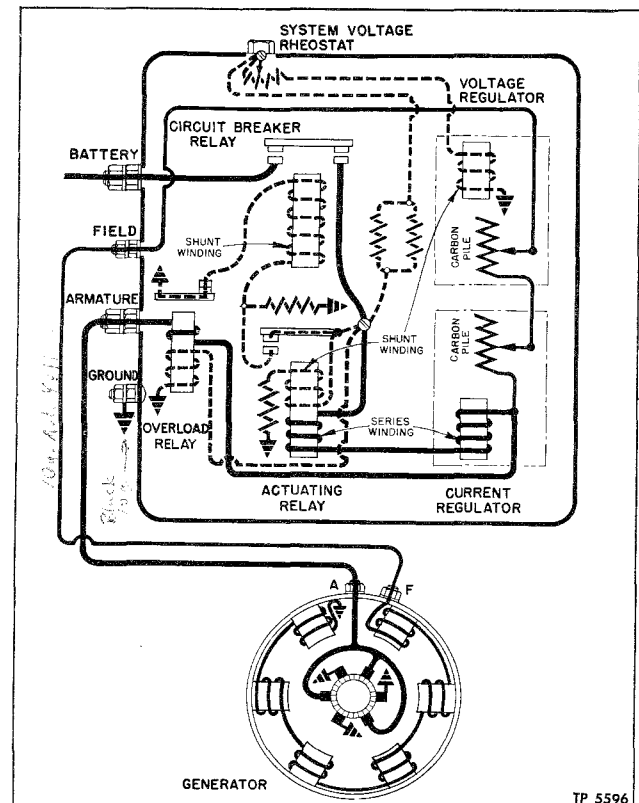


Figure 20—Generator and Regulator Wiring Diagram

REGULATOR

resistance and reducing the voltage or current, depending on which regulator is called upon to function. Under a steady condition of speed and load, the regulator assumes the position required to furnish the proper resistance and remains static as long as this condition persists. This characteristic tends to prolong the useful life of the carbon pile regulator.

The very small change in length of the carbon pile in operation is necessary to prevent uneven operation which might otherwise result from over-control. It is also necessary to use a special spring which closely matches the pull of the electromagnet over the whole range of movement. The effect of surges is partially nullified and stability is improved by the incorporation of a small oil-filled dash pot which acts much like a shock absorber on the movements of the armature of the electromagnet.

SYSTEM VOLTAGE RHEOSTAT

In addition to the current and voltage regulators, which operate as described, a small rheostat is included in the control portion of the regulator. This rheostat, called the system voltage rheostat, is connected in series with the coil of the electromagnet in the voltage regulator and a pair of paralleled fixed resistors (fig. 20). By changing this variable resistance, the voltage setting of the regulator can be raised or lowered within a small range (approximately 3 volts). The system voltage rheostat is mounted on the wall of the box so that it can be adjusted from the outside. This offers a ready means of correcting the system voltage (within limits) without removing the cover of the regulator or changing mechanical adjustments of the units.

ACTUATING, CIRCUIT BREAKER,
AND OVERLOAD RELAYS

The remainder of the regulator is made up of the actuating and circuit breaker relays and the special overload relay. Each of these relays performs a different function and it is important that their operation be understood. Generally speaking, the actuating and circuit breaker relays act together to open and close the battery circuit in accordance with generator voltage, while the overload relay prevents excessive reverse currents. Details of these operations are covered in the following paragraphs.

The actuating relay contains two windings and one set of contact points. One of the windings is a series winding of a few turns of heavy wire (fig. 20) which is part of the charging circuit. The second winding is a shunt winding consisting of many turns of fine wire (shown in dashed lines) which, in series with a resistor, is shunted across the generator. When the generator is not operating,

the actuating relay contact points are held open by the tension of a spiral spring. The circuit breaker relay (fig. 19) contains a shunt winding on a core (shown in dashed lines in fig. 20), above which is an armature with two heavy contact points. Beneath these points are two stationary contact points, one of which is connected through the actuating relay and current regulator series windings to the "ARMATURE" terminal and thence to the insulated terminal of the generator. The other is connected directly to the regulator "BATTERY" terminal and thence to the battery through the wiring circuit. The contact points are held open by the tension of a spiral spring when the generator is not operating.

When the generator begins to operate, a magnetic field is built up by the actuating relay shunt winding. When generator voltage reaches the value for which the relay is adjusted, the magnetic field is sufficiently strong to pull the armature down toward the core, causing the contact points to close. Closing of the contact points connects the circuit breaker relay shunt winding across the generator. This creates a strong magnetic field which pulls the circuit breaker relay armature down so that the contact points close and complete the circuit between the generator and battery. Charging current then flows in the series winding of the actuating relay, building up an additional magnetic field which assists the field of the shunt winding in holding the armature down.

When the generator voltage drops below battery voltage, current flows from the battery to the generator. This reverses the flow of current through the actuating relay series winding. As a result, the magnetic fields of the series winding and the shunt winding no longer assist each other, but become magnetically opposed. The resultant magnetic field becomes too weak to hold the actuating relay armature down and the contact points are opened by spring tension. This interrupts the flow of current to the circuit breaker relay shunt winding, causing a sudden loss of magnetic field strength which releases the armature and allows the contact points to open. The sudden interruption of current flow in the circuit breaker shunt winding causes a surge of induced voltage which is partly dissipated by a resistor connected in parallel with the winding (fig. 20). This resistor action reduces the energy dissipated through arcing at the contacts of the actuating relay.

The overload relay contains two windings and one set of contact points. One of the windings is a series winding consisting of one turn of heavy wire (fig. 20) which is a part of the charging circuit. The second winding is a shunt winding consisting of many turns of fine wire (shown in dashed lines) which is shunted across the generator. The series and shunt windings are wound so that their

Figure 22—Actuating Relay Closing Voltage Adjustment

CIRCUIT BREAKER RELAY

CLOSING VOLTAGE CHECK

With generator inoperative, connect a voltmeter between regulator "ARMATURE" and "GROUND" terminals. Disconnect lead from "FIELD" terminal on regulator and connect a 15 ohm - 15 watt variable resistor in series between lead and terminal. Generator voltage can now be controlled by changing the variable resistance - increasing resistance lowers voltage, decreasing resistance raises voltage. Before starting generator, pull the main fuse or disconnect battery lead at "BATTERY" terminal of generator regulator. Operate generator at about 2500 rpm (1675-1700 engine rpm) with variable resistor in "OFF" position. Hold actuating relay armature down by hand so that the contact points are closed during entire check. Gradually raise generator voltage by turning variable resistor slowly to right until circuit breaker contact points close. Note closing voltage. If check is repeated, generator voltage must be reduced to 1 volt or less each time (by increasing resistance) and then raised again gradually to point where circuit breaker relay contact points close. This is necessary to reduce errors caused by residual magnetism.

CLOSING VOLTAGE ADJUSTMENT

Closing voltage may be adjusted, if necessary, by turning adjusting screw (fig. 21) at base of relay frame. Closing voltage is raised by increasing spring tension and lowered by reducing spring tension.

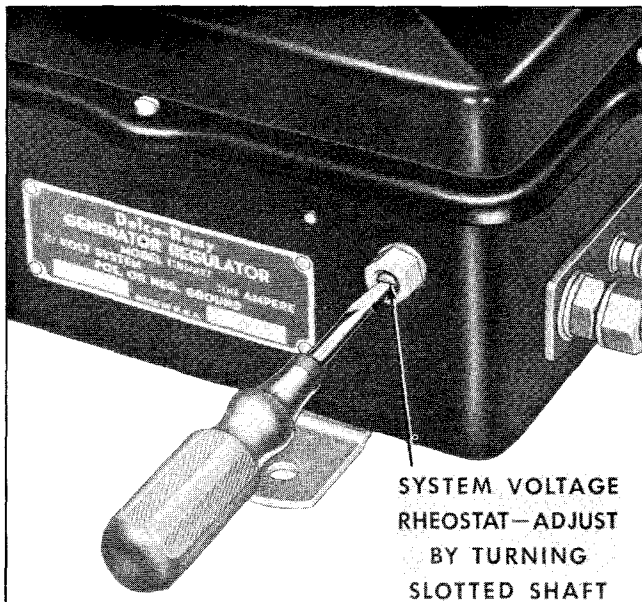


Figure 23—System Voltage Rheostat Adjustment

ACTUATING RELAY

CLOSING VOLTAGE CHECK

Closing voltage of actuating relay is checked in same manner as circuit breaker relay except armatures of both relays are left free to move. Note voltage at which contact points of actuating relay close.

CLOSING VOLTAGE ADJUSTMENT

Adjust closing voltage, if necessary, by turning adjusting screw (fig. 22) at base of relay frame. Closing voltage is raised by increasing spring tension and lowered by decreasing spring tension.

VOLTAGE REGULATOR

The following checks and adjustments are made with generator regulator cover removed and main fuse pulled or battery lead disconnected at generator regulator "BATTERY" terminal.

VOLTAGE SETTING AND FRONT AIR GAP ADJUSTMENT

1. Connect test voltmeter between generator regulator "ARMATURE" and "GROUND" terminals.
2. Set system voltage rheostat (fig. 23) on side of generator regulator box to halfway position. This can be done by turning slotted screw to right and left as far as possible, marking these limits with pencil, and then returning screw to mid-point between these marks.
3. Disconnect lead at generator regulator "FIELD" terminal and connect a 15 ohm - 15 watt variable resistor in series between lead and terminal. Set variable resistor to "OFF" position. The voltage of the generator can now be controlled by turning the variable resistor.

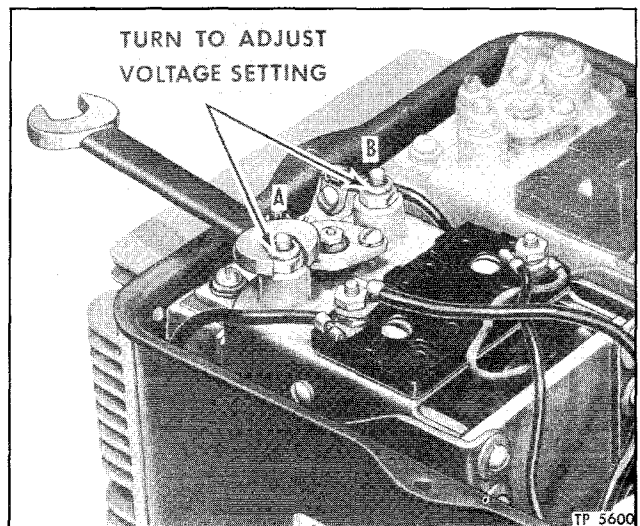


Figure 24—Voltage Regulator Setting Adjustment
(Current Regulator is Adjusted in Same Manner)

REGULATOR

4. Operate generator at approximately 2500 rpm (1675-1700 engine rpm). Gradually turn variable resistor to right until resistance is completely cut out. (If voltage tends to exceed specified limit before resistance is entirely cut out, loosen voltage adjusting nut until resistance can be completely cut out without exceeding maximum limit. Then proceed with Step 5.)

5. Loosen voltage adjusting nut "A" on voltage regulator slowly (fig. 24). As nut is loosened, generator voltage will fall until spring tension is relieved. Loosen only until voltage stops falling. Further loosening may allow spring to unhook.

6. Gradually tighten voltage adjusting nut "B" until voltage reaches 8-9 volts.

7. Tighten nut "A" slowly until voltage reaches 14 volts.

8. Reduce generator voltage to 1 volt or less by increasing resistance of variable resistor in field circuit. Raise voltage again by gradually turning variable resistor to right until resistance is completely cut out. This will allow the circuit breaker relay to close and the voltage to stabilize. Note voltage setting.

9. Check front air gap of voltage regulator (fig. 25) using non-magnetic feeler gauge.

10. Adjust air gap, if necessary, by loosening lock nut and turn stack adjusting screw (fig. 26). Set lock nut when adjustment is correct.

11. Recheck voltage setting as in Step 8. Adjust nuts "A" and "B" (fig. 24) equal amounts

until voltage reaches specified value.

12. Turn slotted screw of system voltage rheostat (fig. 23) to extreme left and then to extreme right. Note if voltage varies smoothly in both directions. (If voltage varies unevenly or erratically, rheostat is faulty and should be replaced.) Turn screw back until voltage is again at specified value. System voltage can now be adjusted within a range of approximately 3 volts if necessary, without changing any mechanical adjustments or removing cover of generator regulator.

CURRENT REGULATOR

The following checks and adjustments are made with generator regulator cover removed and battery disconnected.

CURRENT SETTING AND FRONT AIR GAP

1. Disconnect battery lead at "BATTERY" terminal of regulator, and connect suitable test ammeter and .06 - .08 ohm - 3000 watt fixed resistor in series between "BATTERY" terminal and ground. (If more convenient, pull main fuse and connect test ammeter and fixed resistor at fuse block.) Connect voltmeter between "ARMATURE" and "GROUND" terminal of regulator.

2. Disconnect lead from "FIELD" terminal of regulator and connect 15 ohm - 15 watt variable resistor in series between lead and terminal. Set variable resistor to "OFF" position. Generator voltage can now be controlled by turning the variable resistor.

3. Turn engine up against governor so that generator operates at maximum speed. Gradually raise generator output by turning variable resistor

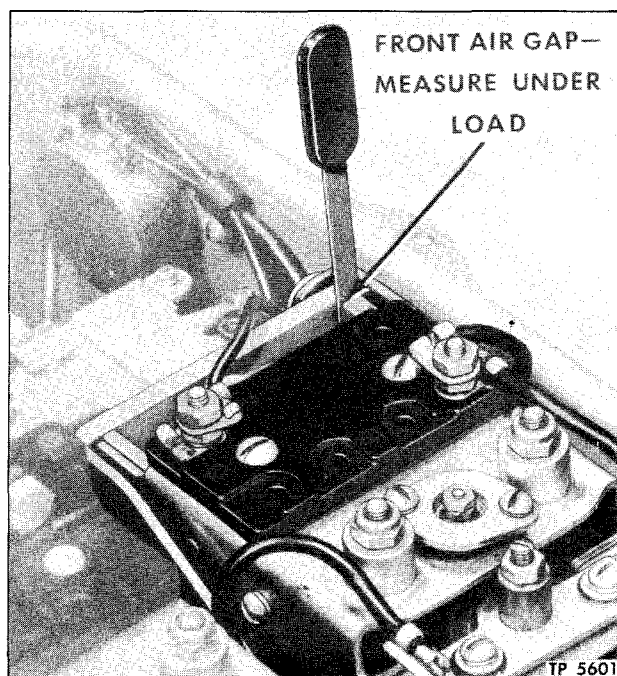


Figure 25—Voltage Regulator Front Air Gap Check
(Current Regulator Front Air Gap is Checked in Same Manner)

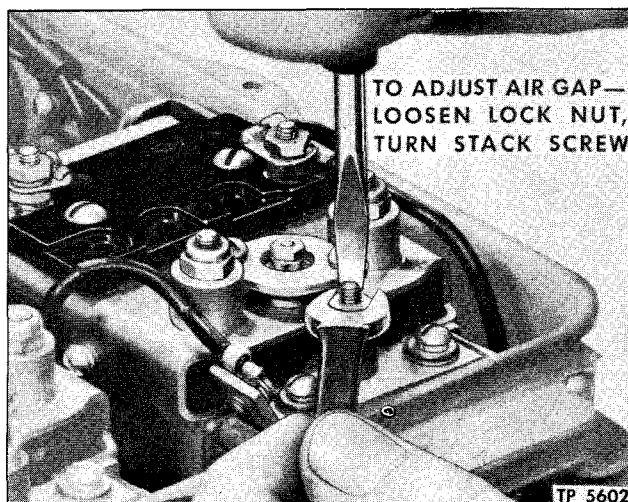


Figure 26—Adjusting Voltage Regulator Front Air Gap
(Current Regulator Front Air Gap is Adjusted in Same Manner)

REGULATOR

slowly to the right until resistance is completely cut out. (If current tends to exceed specified limits before resistance is entirely cut out, loosen current adjusting nut until resistance can be completely cut out without exceeding maximum limit.)

4. Loosen current adjusting nut "A" on current regulator (fig. 24) slowly. As nut is loosened, generator output will fall until spring tension is relieved. Loosen only until output stops falling. Further loosening may allow spring to unhook.

5. Tighten nut "B" gradually until output reaches approximately 80 amperes.

6. Tighten nut "A" slowly until output reaches 135-145 amperes. (Voltage should not exceed 12.5 volts.)

7. Check front air gap with non-magnetic feeler gauge (fig. 25). Adjust front air gap, if necessary, by loosening lock nut and turning stack adjusting screw (fig. 26). Tighten lock nut.

8. Reduce output by gradually turning variable resistor to left (increasing resistance) until current falls to 30 amperes or less. Slowly raise output by turning variable resistor to right until resistance is completely cutout. Note current setting.

9. If necessary, adjust current output to specified value by tightening or loosening nuts "A" and "B" (fig. 24) in equal amounts as required. Check final current setting by lowering and raising output as in Step 8.

NOTE: It is very important that the voltage and current output be reduced to the values given in making these tests and then raised gradually. Otherwise, residual magnetism in the units will cause serious errors in the settings made.

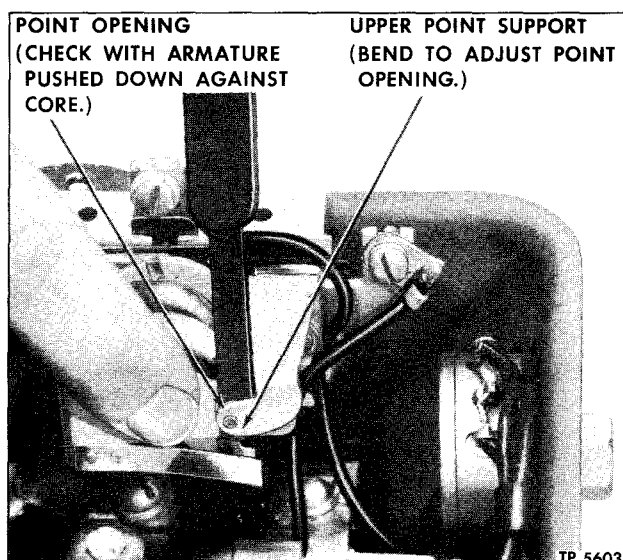


Figure 27—Overload Relay Point Opening Check and Adjustment

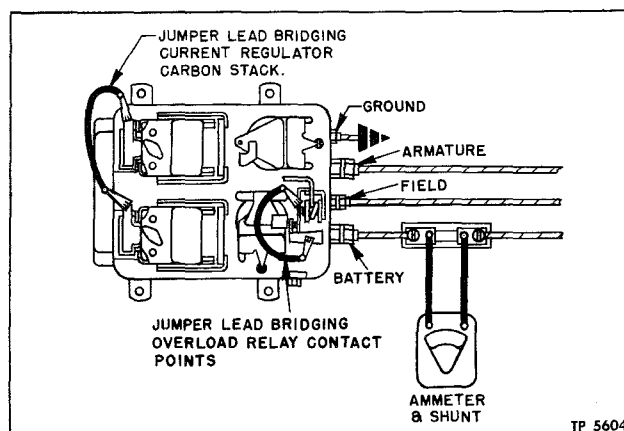


Figure 28—Ammeter and Jumper Lead Connections for Checking Overload Relay Reverse Current

OVERLOAD RELAY

The following checks and adjustments are made with the regulator cover removed and all electrical connections intact. Do not close contact points of actuating or circuit breaker relay by hand when generator is not operating.

POINT OPENING

Hold relay armature against core and measure point opening. Adjust, if necessary, by bending upper contact support (fig. 27).

REVERSE CURRENT SETTING

1. Connect temporary jumper lead across overload relay contact points to prevent opening of circuit breaker relay during test (fig. 28).

2. Shunt out carbon stack of current regulator unit with temporary jumper lead to prevent current regulator action on reverse current (fig. 28).

3. Connect suitable test ammeter in series between battery and "BATTERY" terminal of regulator (fig. 28).

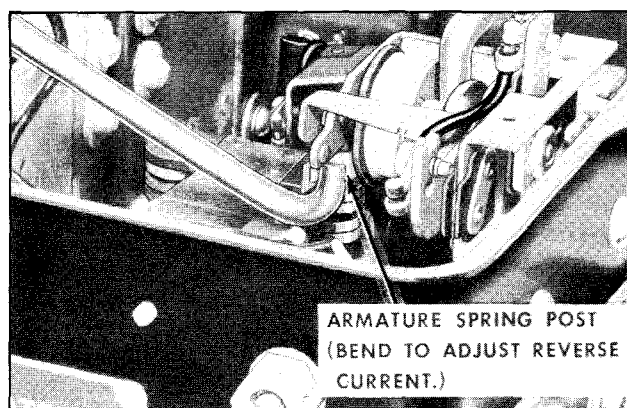


Figure 29—Overload Relay Reverse Current Adjustment

LIGHTING SYSTEM

4. Disconnect lead from "FIELD" terminal of generator regulator and connect 15 ohm - 15 watt variable resistor in series between lead and terminal. Turn variable resistor to right until resistance is completely cut out.

5. Operate generator at approximately 1000 rpm (675 engine rpm). Hold armature of actuating relay down by hand, and gradually reduce generator voltage by turning variable resistor to left (increasing resistance) until reverse current causes overload relay points to open. Note reverse current setting. Increase generator voltage by turning variable resistor completely to right and release actuating relay armature.

6. If necessary, adjust reverse current setting by bending armature spring post (fig. 29). Check final current setting as in Step 5.

SHUNT COIL TEST

Disconnect shunt coil lead, and test continuity of shunt coil circuit to ground. If circuit is open, check connections and replace overload relay if necessary.

POLARITY

After the generator or regulator is reinstalled, or at any time after leads have been disconnected and then reconnected to the regulator, the lead to the "FIELD" terminal of the regulator should be removed and touched momentarily to the "BATTERY" terminal of the regulator, before starting the engine. This allows a momentary surge of current from the battery to the generator which correctly polarizes the generator with respect to the battery it is to charge.

Lighting System

Circuits for all lights used for regular illumination purposes are shown on "Coach Lighting Wiring Diagram" in back of manual. Circuits for lights used as signals, such as stop light, directional signals, and tell-tale lights are shown on "Alarm and Signal Wiring Diagram" in back of manual.

IMPORTANT: All lights should be checked daily and necessary replacements made. Bulb sizes are listed in "Specifications" at end of this group. A spare

headlight sealed-beam unit, stop light bulb, and tail or marker light bulb are carried in a carton in safety compartment.

SWITCHES AND CIRCUIT BREAKERS

All manually operated light switches for exterior and interior lighting equipment, except engine compartment lights, are located on switch panel in front of driver or on toeboard at driver's feet. Engine compartment lights are operated by a manual switch on engine compartment panel.

Baggage compartment light circuits are controlled by switch on panel marked "BAGGAGE." Each compartment light is then controlled by individual switches which are automatically operated by the opening and closing of each baggage compartment door.

Stop lights are controlled by an air-operated switch as explained later under "Exterior Lighting."

All lighting circuits are protected by automatic reset type circuit breakers, mounted below control panel at left of driver. Refer to Wiring Diagrams in back of manual or to "Circuit Breaker Panel" tabulation in "WIRING AND MISCELLANEOUS ELECTRICAL" section at beginning of this group.

EXTERIOR LIGHTING EQUIPMENT

HEADLIGHTS

Headlights (fig. 30) are double-filament, Sealed-Beam type. The lens, reflector, and filament are a sealed unit and can be replaced only as such. If lens is cracked, filament burned out, or reflec-

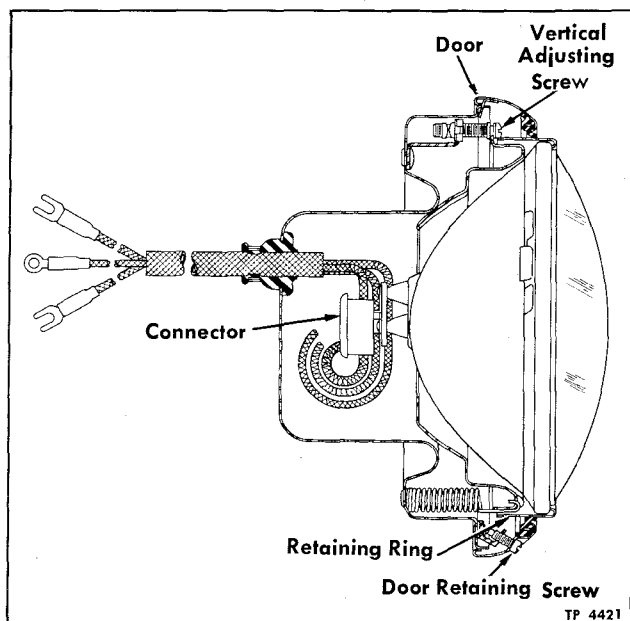


Figure 30—Sectional View of Headlight

LIGHTING SYSTEM

tor damaged, the complete unit must be replaced.

With switch marked "HEAD" on panel turned on, headlight and fog light circuits are energized. The headlight or fog light circuit is then selected by the foot-operated selector switch on toeboard. When headlights are used, upper or lower headlight beam is selected by the foot-operated dimmer switch on toeboard. Tell-tale light on gauge panel marked "HI BEAM" illuminates when headlight upper beam is being used.

Proper Use of Headlights

Headlights are designed to provide adequate highway lighting for normal operating conditions. The headlights will provide safe lighting, providing they are aimed correctly, equipped with proper Sealed-Beam units, lens are clean, and upper and lower beams are used correctly.

1. Upper Beam. High beam should be used only on unlighted roads when no approaching vehicles are near.

2. Lower Beam. Lower beam should always be used when approaching another vehicle. The depressed beam provides safer road visibility than upper beam under passing conditions, providing both vehicles use the depressed beam.

3. Headlight Lens. Dirt on lens absorbs a considerable amount of light. Clean lens with water and a good glass cleaner whenever dirty.

4. Headlight Wiring. For maximum illumination, proper voltage must be obtained at the bulb. Discharged battery, loose or dirty electrical contacts in wiring system, and poor ground connections all contribute to a decrease in voltage. Check wiring and connections regularly, make sure generator is charging sufficiently, and keep battery properly charged.

Sealed-Beam Unit Replacement (Fig. 30)

Headlight Sealed-Beam unit may be replaced in following manner:

1. Remove rim retaining screw and remove rim.
2. Remove three retaining screws.
3. Pull Sealed-Beam unit out of light body, disconnecting wiring as unit is removed.
4. Insert prongs of new Sealed-Beam unit into wiring plug, then position unit in light body.
5. Install Sealed-Beam unit retaining ring and attach to light body with three screws.
6. Install door with clip engaging slot at top of light body. Install door retaining screw at bottom of door, tightening screw firmly.

Headlight Adjustment

Headlights must be aimed carefully and accurately to assure safe vehicle operation at night. Adjustments can be made quickly and accurately

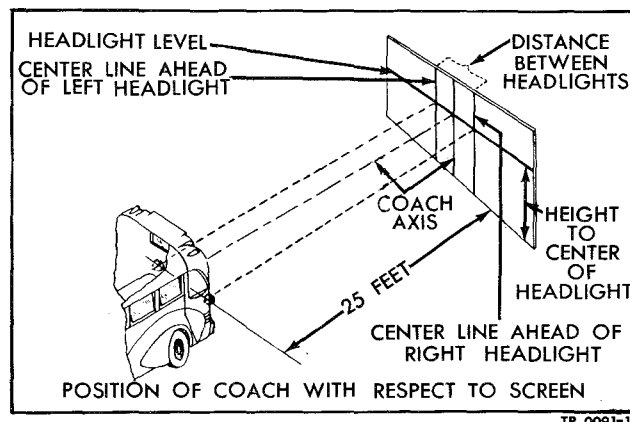


Figure 31—Headlight Aiming Chart

with a headlight tester, but if such equipment is not available, adjust lights as follows:

1. Position vehicle on level floor with headlights 25 feet from a vertical wall or door as shown in figure 31. Vehicle center line must be perpendicular to vertical surface.

2. Draw a horizontal line on vertical surface at height of light center as shown in figure 31. Locate a point on this horizontal line at which projected center line of chassis intersects. Measure distance between light centers and divide the distance equally on either side of center mark. Then draw a vertical line directly ahead of each light center as shown.

3. Switch on high or bright beam in headlights and cover one light while adjusting other.

4. Remove door retaining screw (fig. 30), and door for access to adjusting screws. Top screw provides vertical adjustment and side screw aims light horizontally.

5. Beam pattern should approximate that shown in figure 32. A distorted beam pattern is usually caused by a sprung reflector, in which event Sealed-Beam unit must be replaced.

6. After headlight is properly aligned, cover its beam and proceed in same manner as above with opposite light.

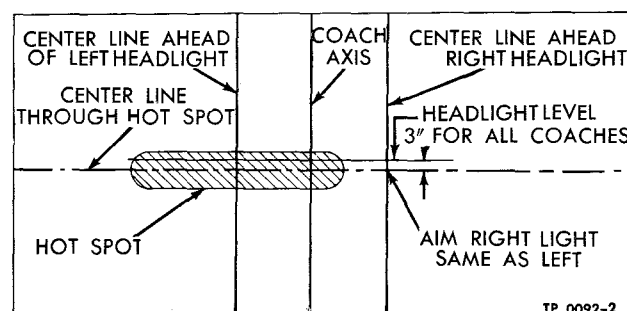


Figure 32—Headlight Beam Pattern

LIGHTING SYSTEM

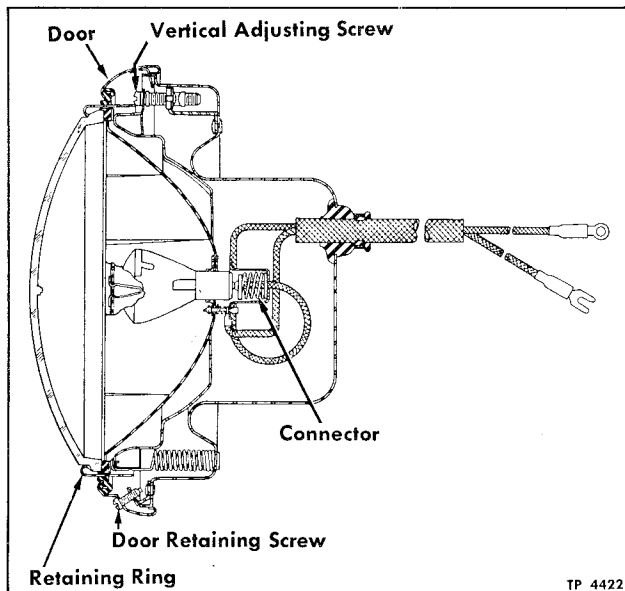


Figure 33—Sectional View of Fog Light

HEADLIGHT DIMMER SWITCH, AND HEAD AND FOG LIGHT SELECTOR SWITCH

Foot-operated switches located on toeboard near steering column are used to select either the headlight or fog light circuit, and to select either headlight upper or lower beam when headlights are being used. These switches are operative only when switch marked "HEAD" on panel is in on position. Switch at left of steering column is headlight dimmer switch; switch at right is head and fog light selector switch.

Switches require no maintenance; however, switch may be replaced by removing mounting bolts, after which switch is readily accessible from under floor.

When installing switch, connect wires to terminals before attaching switch to mounting bracket.

IMPORTANT: Correct wire must be connected to switch terminal marked "BAT" as follows: Dimmer switch - black with red check; selector switch - black with two green parallel tracers. Connect other two wires to remaining terminals; position of these wires with respect to terminals is not important.

FOG LIGHTS

Fog lights (fig. 33) are mounted at lower front corners of coach directly below headlights and behind outer ends of front bumper. Openings are provided in bumper at fog lights. A special bulb with a metal fog cap to prevent glare from direct rays, and an amber lens are the identifying characteristics of this type of light.

Fog light circuit is energized by foot-operated

selector switch after switch marked "HEAD" on panel is in on position. Either the headlights or fog lights are on when the "HEAD" switch is on, never both at the same time.

Fog Light Bulb Replacement (Fig. 33)

1. Remove tire compartment door cap nuts and washers from studs located in bumper openings between fog light openings. Swing bumper and tire compartment door downward.

2. Remove fog light door retaining screw, then remove door (fig. 33).

3. Remove three retaining ring screws, then remove retaining ring and lens.

4. Press in on bulb, at same time turning bulb counterclockwise to remove bulb.

5. Position new bulb in light with prongs engaged in holes in bulb flange. Due to prong spacing bulb can be installed in only one position.

6. Press bulb in firmly, turning bulb clockwise at the same time. Make sure all prongs are properly engaged.

7. Install lens, retaining ring, and three retaining ring screws.

8. Install door, engaging clip on door in slot at top of light body. Fasten door with retaining screw.

9. Swing bumper and tire compartment door up into position and secure with cap nuts.

Fog Light Adjustment

Refer to "Headlight Adjustment" previously in this section. Fog lights are adjusted in same manner as headlights; however, beam pattern differs from headlight pattern. Fog light "Hot Spot" is more concentrated around center line of light, and "cut-off" at top of beam is more sharply defined than on headlights. Swing bumper and tire compartment door downward as directed in step 1 under "Fog Light Bulb Replacement" for access to fog lights.

MARKER LIGHTS

All marker lights are controlled by switch marked "MARK" on switch panel and are protected by circuit breaker number 10 on panel at left of driver.

Front and rear corner marker lights are attached to body at roof corners. For access to bulbs, remove two screws attaching lamp assembly to body, remove lamp assembly, then remove lamp back.

Front and rear Michigan Marker lights are mounted on roof panel at center of coach. Bulbs are accessible after loosening clamp ring screw, then removing clamp ring, lens, and gasket.

TAILLIGHTS

Taillight at each rear corner is incorporated in the combination tail, stop, and directional signal

LIGHTING SYSTEM

light, mounted in engine compartment door. Two bulbs in each assembly illuminate a red horizontal bar at top and bottom of lens. Taillight circuit is controlled by "MARK" switch on switch panel and is protected by number 10 circuit breaker on panel at left of driver. Refer to "Coach Lighting Wiring Diagram" in back of manual for taillight circuit.

Taillight bulbs are accessible after removing four screws attaching lens retainer to light body and removing retainer, gasket, and lens. Make sure gasket is in good condition and properly positioned when installing lens.

STOP LIGHTS

Stop light at each rear corner is incorporated in the combination tail, stop, and directional signal light, mounted in engine compartment door. Two bulbs in each assembly illuminate red "STOP" sign in center of lens when brakes are applied.

Stop light circuit is controlled by an air-operated stop light switch mounted on top of rear brake relay valve, and a two-unit relay mounted on engine compartment panel. Circuit as protected by a circuit breaker on engine compartment panel. Refer to "Alarm and Signal Wiring Diagram" in back of manual for stop light circuits.

Tell-tale light on gauge panel marked "STOP LAMP" illuminates when stop lights are illuminated. Tell-tale is controlled by the relay, and will not illuminate if a stop light bulb is burned out or if bulbs of lower candle power than listed in "Specifications" are used.

Stop light bulbs are accessible after removing four screws attaching lens retainer to light body and removing retainer, gasket, and lens. Make sure gasket is in good condition and properly positioned when reinstalling lens.

STOP LIGHT SWITCH (Fig. 34)

Air-operated stop light switch is mounted on top of rear brake relay valve as shown in "Air Line Diagram" at beginning of BRAKES (SEC. 4). When brakes are applied, contacts within switch are closed by air pressure, completing circuit to stop light relay.

Switch Removal

Disconnect wires from switch terminals, then unscrew switch from fitting on relay valve.

Switch Repair

Disassemble switch and examine diaphragm and contact points. Replace diaphragm if cracked or damaged. If contact points are only slightly burned or pitted, they may be reconditioned using a contact point file. If points are badly damaged, terminal screw and contact plunger with new points should be installed. Replace spring if weakened by rust or corrosion. Make sure vent hole in cover is open.

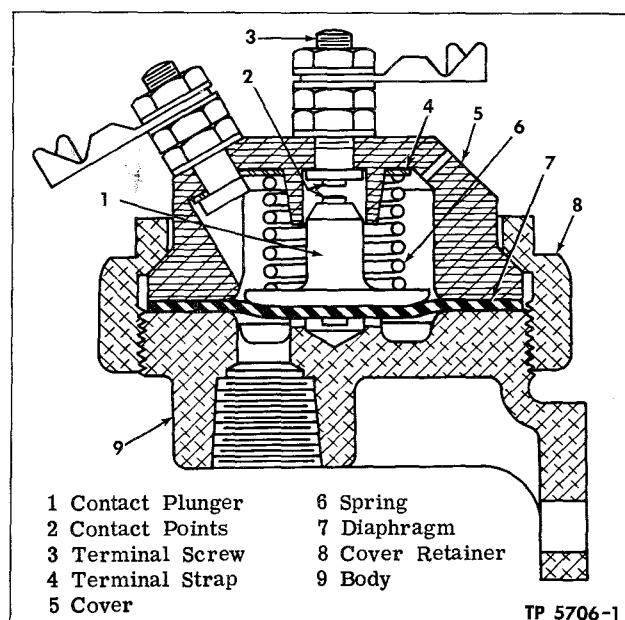


Figure 34—Stop Light Switch

Switch Installation

Thread switch onto fitting on top of relay valve. Connect wires to switch terminals. Apply brakes and check operation of stop lights.

STOP LIGHT RELAY

Operation, maintenance, and adjustment of stop light relay are described under "Relays" in "WIRING AND MISCELLANEOUS ELECTRICAL" section at beginning of this group.

DIRECTIONAL SIGNAL LIGHTS

Directional signal lights are controlled by a self-cancelling switch mounted on steering gear housing. Pulling switch lever up turns on left-hand front and rear directional signal lights, and pressing lever down turns on right-hand signal lights. When turn is completed, switch lever automatically returns to off positions. Tell-tale light at lower right-hand corner of switch panel flashes on and off when either the right- or left-hand signal lights are illuminated. Directional signal light circuit is protected by number 12 circuit breaker on panel at left of driver. Refer to "Alarm and Signal Wiring Diagram" in back of manual.

Rear directional signal lights are incorporated in combination tail, stop, and directional signal lights mounted in engine compartment door. One bulb illuminates arrow head when directional switch lever is in turn position; this circuit is connected through a flasher so light flashes on and off until turn is completed.

Front directional signal lights are mounted at each end of front destination sign. One bulb in each light illuminates the arrow head and two bulbs

LIGHTING SYSTEM

illuminate the arrow shaft. The arrow shaft bulbs remain illuminated constantly with directional switch in turn position; the arrow head bulb is connected through a flasher so light flashes on and off until turn is completed.

Front and rear directional light bulbs are accessible after removing four screws attaching lens retainer to light body and removing retainer, gasket, and lens. Make sure gasket is in good condition and properly positioned when reinstalling lens.

HIGHWAY (TARGET) SIGN LIGHTS

Eight bulbs, illuminating highway sign at rear of vehicle, are controlled by "MARK" switch on switch panel. Light bulbs are accessible at inner side of engine compartment door after door is opened.

LICENSE PLATE LIGHT

License plate light, mounted directly over license plate holder at left rear corner of vehicle, is controlled by "MARK" switch on switch panel.

Bulb is accessible for replacement by removing light cover, cap, and glass which are attached by two screws.

DESTINATION SIGN LIGHTS

Three bulbs, mounted behind destination sign curtain, provide illumination for destination sign. Lights are controlled by "SIGN" switch on switch panel. Refer to "Coach Lighting Wiring Diagram" in back of manual for wiring circuits. Bulbs are accessible for replacement from inside vehicle under windshield ledge.

SPOT LIGHT

Spot light is mounted through front corner post at left of windshield. Beam is directed by handle, which also contains the light switch, from inside vehicle. Spot light circuit is protected by number 7 circuit breaker on panel at left of driver. Spot light is equipped with Sealed-Beam unit.

To replace Sealed-Beam unit, remove screw attaching ornament to bottom of light body and remove ornament. Loosen clamp ring screw and remove ring and lens. Remove Sealed-Beam unit from light body and disconnect wires from back of unit. Install new Sealed-Beam unit by reversing the above procedure.

INTERIOR LIGHTING EQUIPMENT

GAUGE PANEL LIGHTS

Gauges in gauge panel in front of driver are illuminated when "MARK" switch on switch panel is turned on.

Light bulbs are accessible by pulling bulb socket free from back of panel. Bulb can then be re-

moved from socket. After replacing bulb, press socket firmly into holder in back of panel.

STEPWELL LIGHTS

Front entrance door stepwell is illuminated by two lights, one mounted on body inside front panel and the other at right front seat floor overhang. Light circuit, protected by number 8 circuit breaker on panel at left of driver, is energized when "STEP" switch on switch panel is turned on; circuit is further controlled by a switch which is actuated by the door control linkage. Lights operate only when "STEP" switch is turned on and front door is open.

To replace bulb in light mounted on body panel, remove lens and retainer which are attached to light body with three screws. Light bulb at right front seat floor overhang is not covered.

GENERAL (DOME) LIGHTS

General interior lights are mounted on package rack support (ten each side), and are controlled by top left-hand switch on switch panel. With switch in "GENERAL" position, circuit through general light relay coil is energized. Relay points then close and complete circuit to lights. Circuit through switch to relay coil is protected by number 12 circuit breaker, and circuit through relay to lights is protected by number 24 circuit breaker. Refer to "Coach Lighting Wiring Diagram" in back of manual. Maintenance and adjustment of relay are described under "Relays" in "WIRING AND MISCELLANEOUS ELECTRICAL" Section.

Remove screws attaching lens and retainer to body to gain access to bulbs.

READING LIGHTS

Reading lights are mounted in under side of package racks (ten each side and one above rear lounge seat), and are controlled by top left-hand switch on switch panel. When switch is in "READING" position, circuit through reading light relay coil is energized. Relay points then close and complete circuit to reading lights. Individual switches at each light then permit passenger control of lights. Refer to "Coach Lighting Wiring Diagram" in back of manual.

Each light has two bulbs and two switches, except rear lounge light which has only one bulb. To replace bulbs in reading lights, pry lens retainer off light body, using screw driver in notch in retainer on side away from aisle. To replace bulb in rear lounge light, remove screw from one end of door and swing hinged door downward.

AISLE LIGHTS

Three light bulbs are mounted on seat floor overhang at sides of aisle, two on left side and one on right side. Lights are controlled by switch on panel marked "AISLE." Bulbs are not covered.

ELECTRICAL SPECIFICATIONS

DRIVER'S LIGHT

Driver's light, mounted on trim panel above drivers window, is controlled by switch on panel marked "DRIVERS." Bulb is accessible after removing lens and retainer which are secured to light body with three screws.

TELL-TALE LIGHTS

Use of tell-tale lights is described under "Tell-tale Alarm System" in "WIRING AND MISCELLANEOUS ELECTRICAL" section. Refer to "Alarm and Signal Wiring Diagram" in back of manual for tell-tale circuits.

BAGGAGE COMPARTMENT LIGHTS

Baggage compartment lights are controlled by individual switches as each door is opened and closed, when switch marked "BAGGAGE" on switch panel is turned on. Bulbs are accessible after removing lens retainer, which is attached with three screws.

ENGINE COMPARTMENT LIGHTS

Engine compartment lights are controlled by a switch on engine compartment panel. Bulbs are exposed and are readily accessible for replacement.

Electrical Specifications

WIRING AND MISCELLANEOUS ELECTRICAL

(Service information on pages 99 through 114)

FUSES

Master (on engine comp't. panel) Part No. 2256452
Speedometer Drive Unit Line Fuse (at engine comp't. junction panel) 6 amp.

CIRCUIT BREAKERS

Refer to "Circuit Breaker Panel" Tabulation

HORN

Make Delco-Remy
Model 1999700
Voltage 12
Air Gap 0.030" - 0.034"
Current 3.5 - 5.5 Amps.
Frequency 300 - 320

HORN RELAY

Make Delco-Remy
Model 1116818
Air Gap - Points Closed 0.022"
Point Opening 0.030"
Closing Voltage
Operating Range 6.0 - 8.0
Adjust to 7.0
Armature to Seal to Core 11 volts Max.

REVERSE, STARTER, BLOWER,
AND LIGHTING RELAYS

Make Delco-Remy
Model 1116852
Air Gap - Points Closed 0.022"
Point Opening 0.030"
Closing Voltage - Minimum 7.0
Armature to Seal to Core 9 volts Max.

STOP LIGHT RELAY

Make Delco-Remy
Model 1116860
Air Gap 0.018"
Point Opening 0.020"
Contact Points to Close 2.4 Amps.
Contact Points to Open 1.5 Amps.

ENGINE STOP & EMERG. STOP SOLENOIDS

Make Delco-Remy
Model 001424
Current Consumption (@ 80° F.) 12.0-13.0 Amps.
Volts 12

REVERSE SOLENOID

Make Delco-Remy
Model 001535
Current Consumption (@ 80° F.)
Both Windings
Amperes 35.0-38.0
Volts 12
Hold-in Winding
Amperes 9.2-10.9
Volts 12

STARTER SOLENOID

Make Delco-Remy
Model 1118171
Current Consumption (@ 80° F.)
Both Windings
Amperes 49.0-55.0
Volts 10
Hold-In Winding
Amperes 11.0-13.0
Volts 10

TELL-TALE ALARM BUZZER

Make Edwards
Model CS-386

TELL-TALE ALARM & MOTO-GARD RECTIFIER

Make Fansteel Metallurgical Corp.
Model BD-1006

MOTO-GARD UNIT

Make Moto-Gard Co.
Model 12-D

MOTO-GARD RELAY

Make Delco-Remy
Model 1116845
Air Gap 0.012"
Point Opening 0.020"
Points to Open
Range 9.0-10.6 Volts
Adjust to 9.5
Points to Close 6.0 Volts Min.

AIR INJECTOR SHUT-OFF

MAGNET VALVE

Make Skinner Chuck Co.
Model V5-4060

ELECTRICAL SPECIFICATIONS

BATTERY

(Service information on pages 115 and 116)

Make	Delco-Remy
Model	(1890297) 8D27WC3
Quantity	Two, connected in parallel
Voltage	12
Plates per Cell	27
Ampere Hour (Each Battery)	155 @ 4 hour rate
Specific Gravity - Fully Charged (@ 80°F.)	1.275-1.290
Recharge at	1.225

STARTING SYSTEM

(Service information on pages 116 through 120)

STARTER

Make	Delco-Remy
Model	1108807
Rotation - Viewed at Drive End	Counterclockwise
Brush Spring Tension	36-40 oz.

No-Load Test

Maximum Amps.	115
Volts	11.6
Approximate rpm	7000

Lock Test

Maximum Amps.	570
Volts	2.3
Torque (Minimum)	20 Lbs. Ft.

STARTER SOLENOID AND RELAY - Specifications are listed under "WIRING AND MISCELLANEOUS ELECTRICAL" on preceding page.

GENERATOR

(Service information on pages 121 through 125)

Make	Delco-Remy
Model	1117602
Rotation - Viewed at Drive End	Counterclockwise
Brush Spring Tension	20 oz.
Field Current at 12 Volts (@ 80°F.)	6.0-6.85 amps.

COLD OUTPUT

Amperes	140
Volts	13
Approximate rpm	1450

HOT OUTPUT Controlled by current regulator

REGULATOR

(Service information on pages 126 through 132)

Make	Delco-Remy
Model	1118408
Type	Carbon Pile

MECHANICAL ADJUSTMENTS

Actuating Relay

(a) Air Gap Between Armature and Core (points just touching)	0.035"-0.042"
(b) Air Gap Between Armature and Heel Iron (armature sealed against core)	0.004"-0.011"
(c) Point Opening	0.024"-0.031"

Circuit Breaker Relay

(a) Air Gap Between Armature and Core (points just touching)	0.029"-0.036"
(b) Air Gap Between Armature and Heel Iron (armature sealed against core)	0.004"-0.011"
(c) Point Opening	0.038"-0.052"

Continued on next page

ELECTRICAL SPECIFICATIONS

MECHANICAL ADJUSTMENTS (Cont'd.)

Voltage & Current Regulators

- (a) Air Gap (armature loaded and parallel to core and frame) 0.015"-0.018"
- (b) Front Air Gaps with Units Operating 0.021" minimum with 0.006" maximum difference between sides

Overload Relay

- (a) Air Gap Between Armature and Core 0.024"-0.032"

ELECTRICAL ADJUSTMENTS (The following values to be used only with Regulator at operating temperature.)

Actuating Relay

- (a) Satisfactory Operating Range 12.2-13.3 volts
- (b) Adjust to 12.8 volts if relay is outside this range

Circuit Breaker Relay

- (a) Satisfactory Operating Range 6.5-8.5 volts
- (b) Satisfactory Sealing Voltage 11.0 volts max. but at least 1 volt above closing voltage

Voltage Regulator

- (a) Satisfactory Operating Range 13.9-14.7 volts
- (b) Adjust to 14.3 volts if regulator is outside this range

Current Regulator

- (a) Satisfactory Operating Range 135-145 amps.
- (b) Adjust to 140 amps. if regulator is outside this range

Overload Relay

- (a) Satisfactory Operating Range 120-160 amps. reverse current at 10-12 volts; 220 (Min.) amps. charging current at 14-15 volts.
- (b) Adjust to 140 amps. reverse current at 10-12 volts if relay is outside this range.

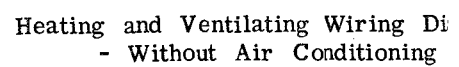
LIGHTING SYSTEM

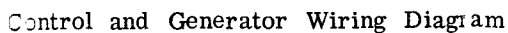
(Service information on pages 132 through 137)

LIGHT BULB SIZES

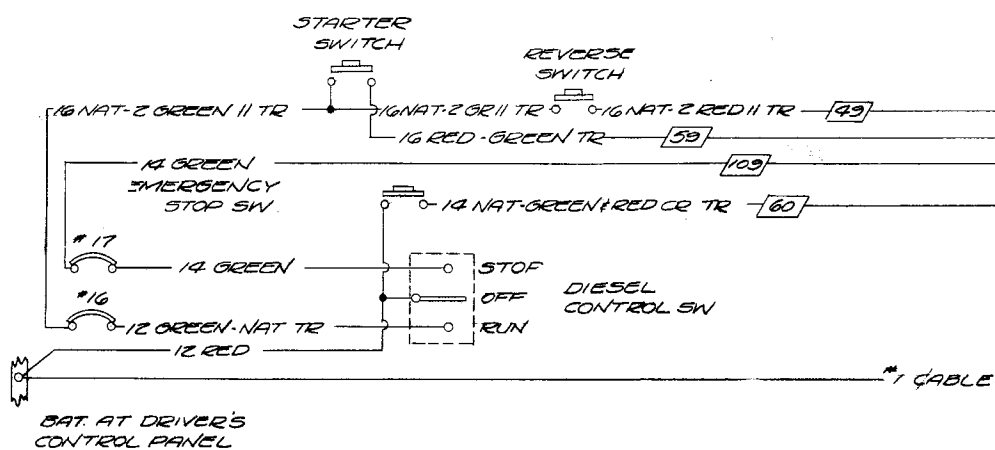
Qty.	Trade			Qty.	Trade		
	No.	C.P.	Contact		No.	C.P.	Contact
2 Headlight (Sealed Beam Unit)	4430	--	--	41 Reading Lights	93J*	15	SC
5 Gauge Panel Lights	89	6	SC	General (Dome) Lights			
8 Target Sign Lights	68	3	DC	4 2 Front and 2 Rear	94	15	DC
1 License Plate Light	67	3	SC	16 All Others	93	15	SC
2 Front Corner Marker Lights	68	3	DC	1 Driver's Light	94	15	DC
3 Front Michigan Marker Lts.	68	3	DC	1 Spotlight (Sealed Beam Unit)	4435	--	--
2 Rear Corner Marker Lights	68	3	DC	2 Fog Lights	1011	32	SC
3 Rear Michigan Marker Lts.	68	3	DC	1 Entrance Door Light	1141	21	SC
7 Telltale Lights	68	3	DC	Front Directional Signal Lights			
1 Emergency Door Light	68	3	DC	2 Arrow Head	1141	21	SC
4 Taillights	67	3	SC	4 Arrow Shaft	89	6	SC
6 Aisle Lights	89	6	SC	Rear Directional Signal Lights			
3 Front Destination Sign Lights	90	6	DC	2 Arrow Head	1141	21	SC
5 Baggage Compartment Lights	90	6	DC	4 Arrow Shafts	67	3	SC
3 Engine Compartment Lights	93	15	SC	4 Stop Light	1141	21	SC

*J - Inside Frost. All bulbs are 12-16 Volt rating.

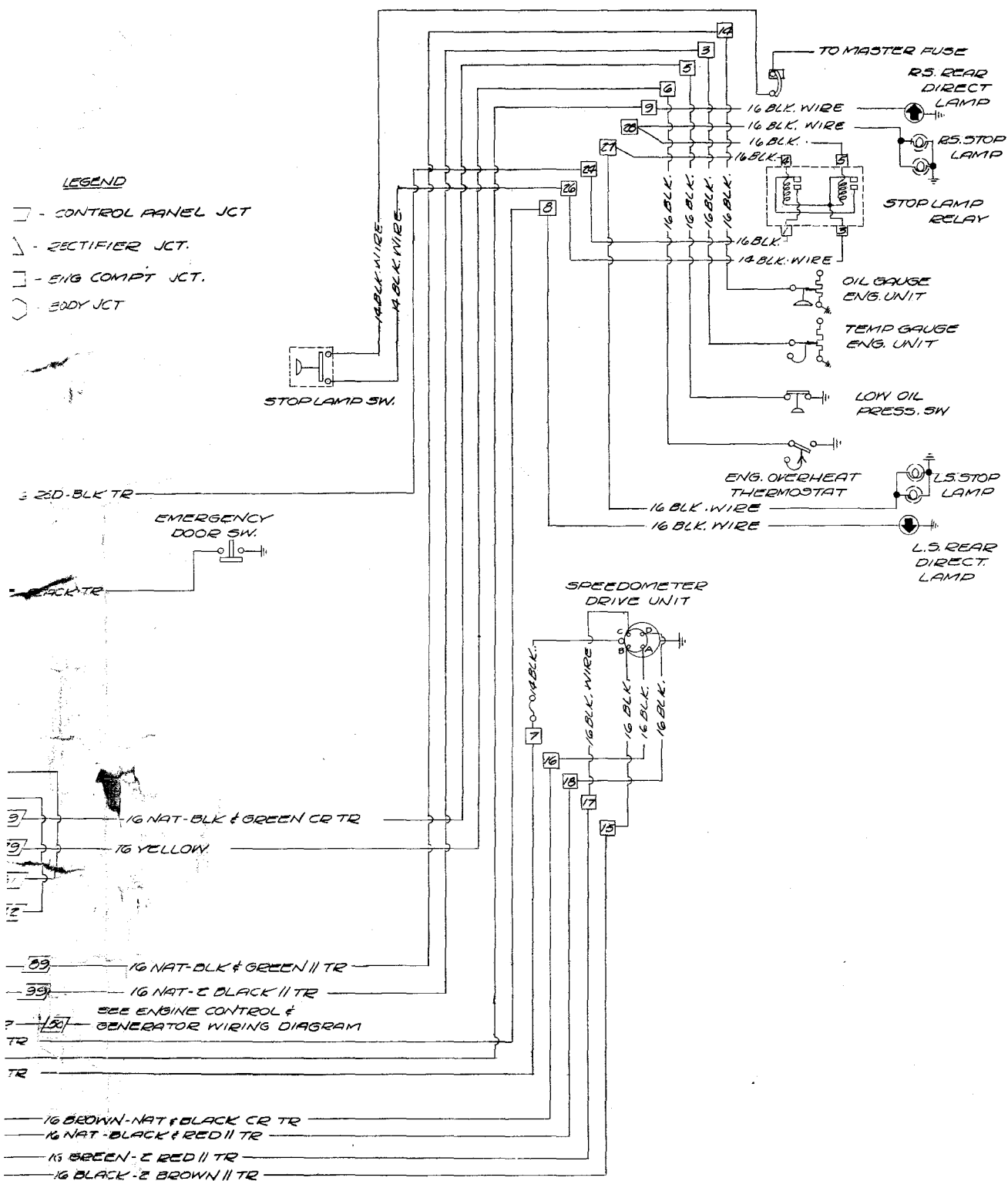




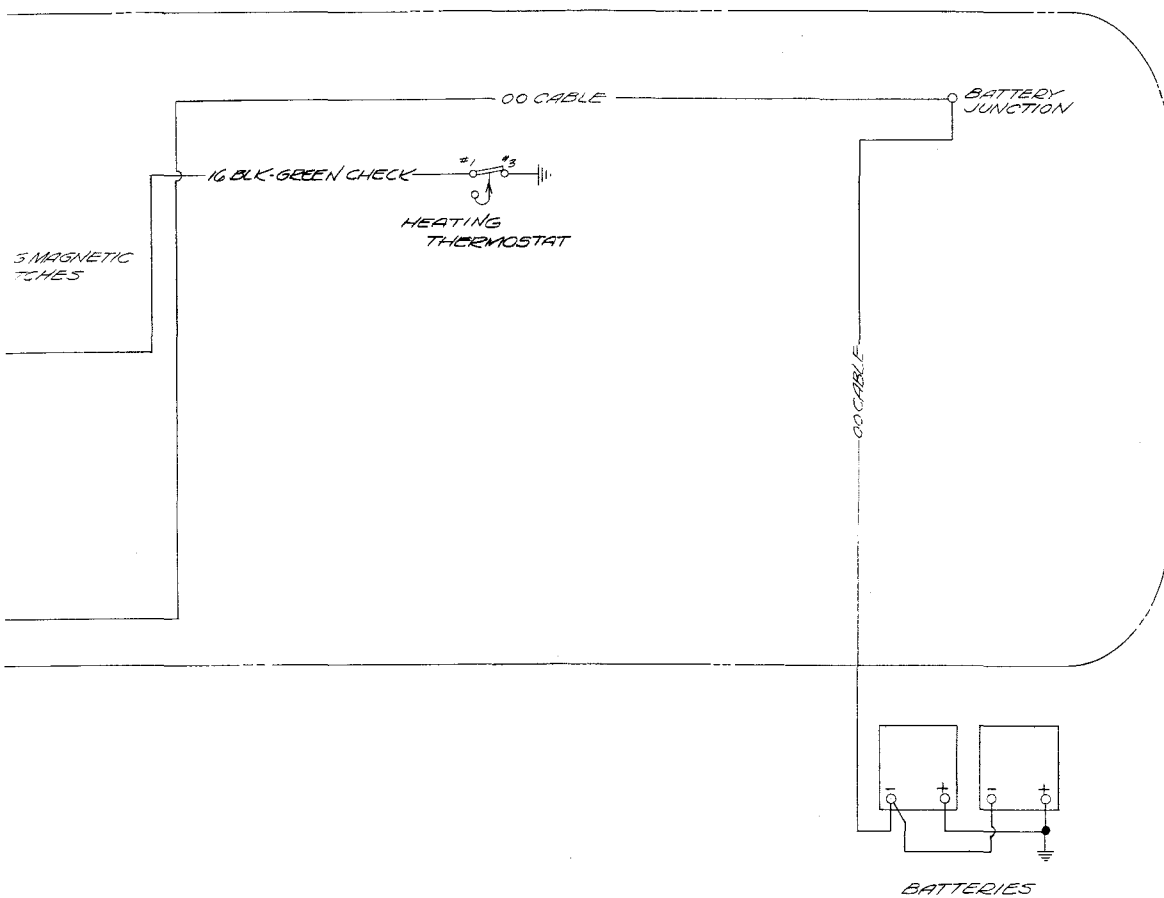
TO GENERATOR TELL-
TALE, SEE ALARM &
SIGNAL WIRING DIAGRAM



Engine Control and Generator Wiring



5 ROTATION WHEN
FOR



LEGEND

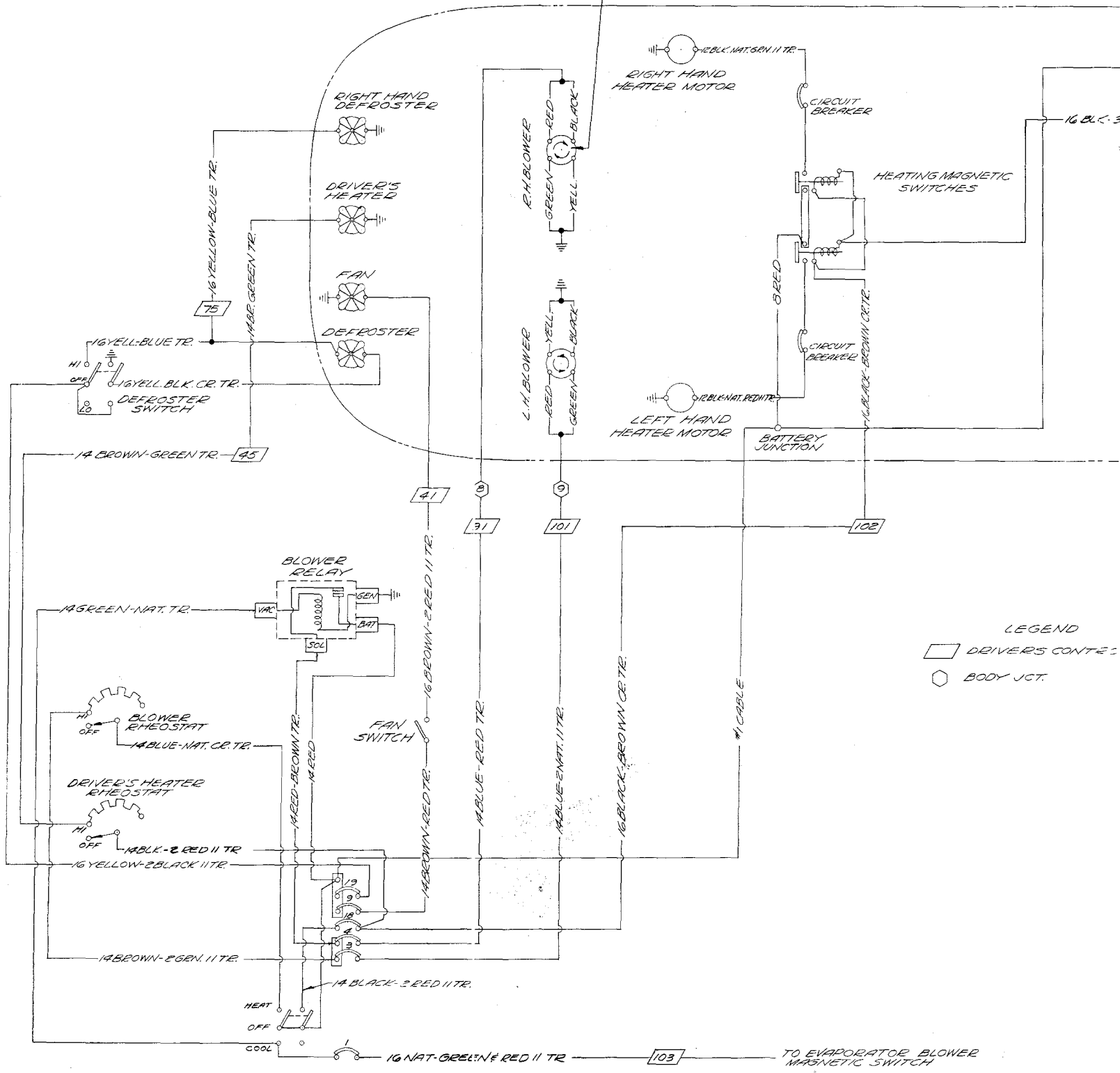
DRIVERS CONTROL PANEL JCT.

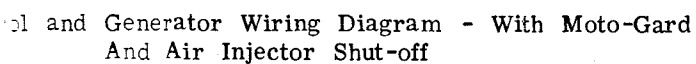
BODY JCT.

NOTE:
FOR USE WITH AIR CONDITIONING
ONLY

Heating and Ventilating Wiring Diagram - With Air Conditioning

ARROWS INDICATE DIRECTION OF ROTATION WHEN VIEWED FROM FAN END OF MOTOR

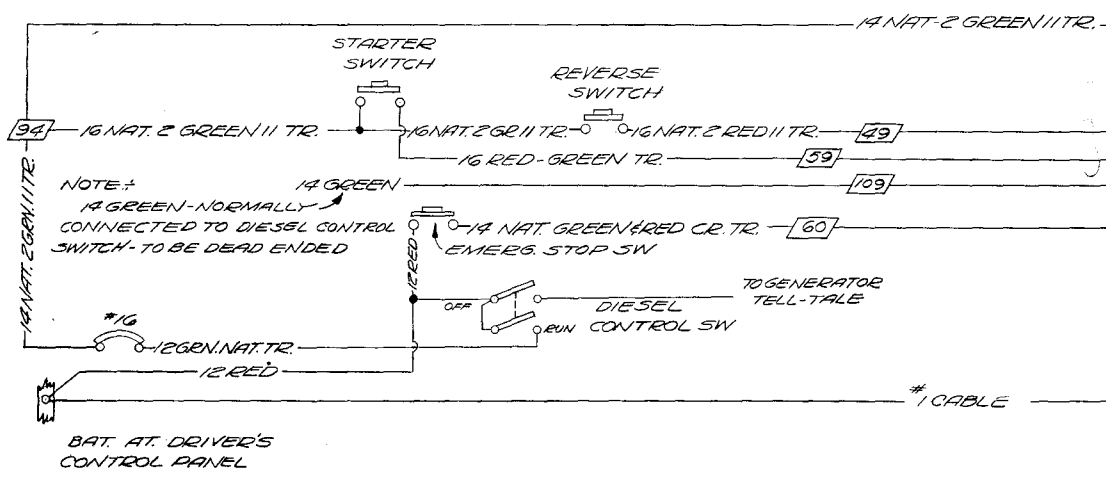




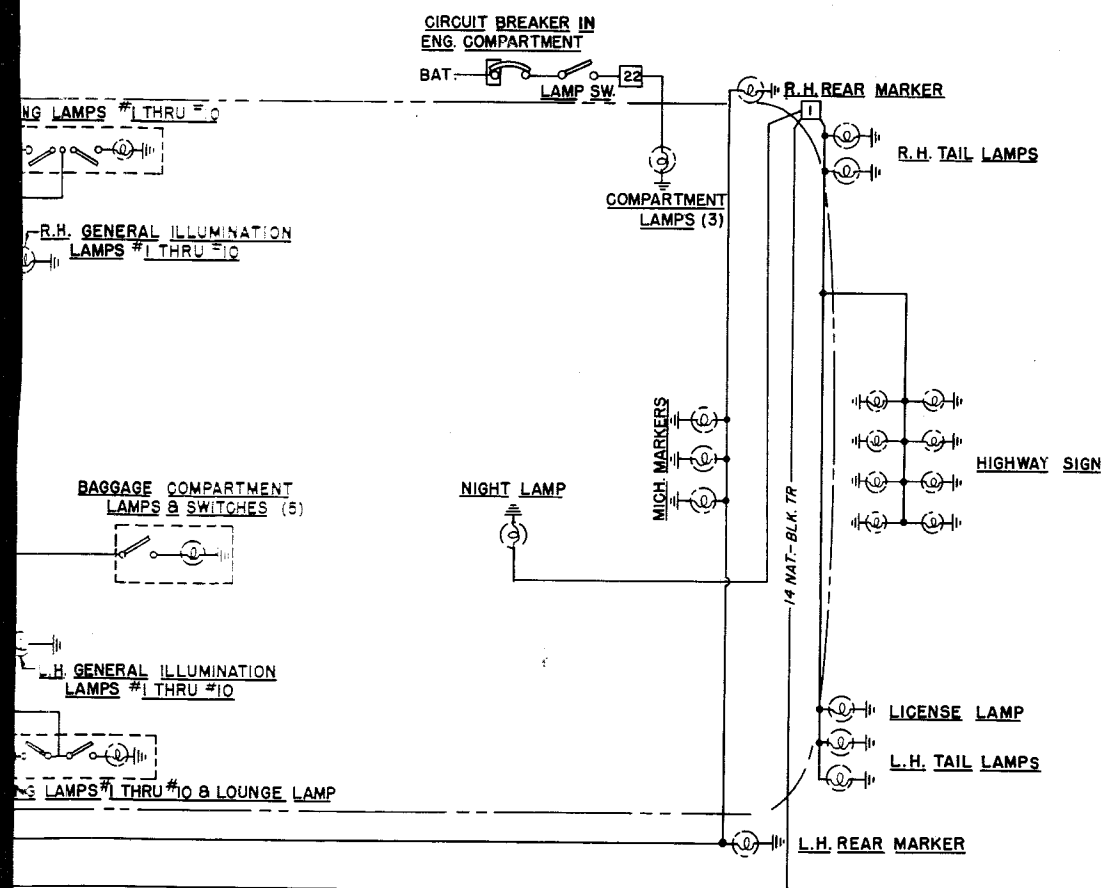
SEE ALARM & SIGNAL
WIRING DIAGRAM

TO GEN.
TO ENG. O.V.E.
TC

FRONT



Engine Control and Generator
And Air In



LEGEND

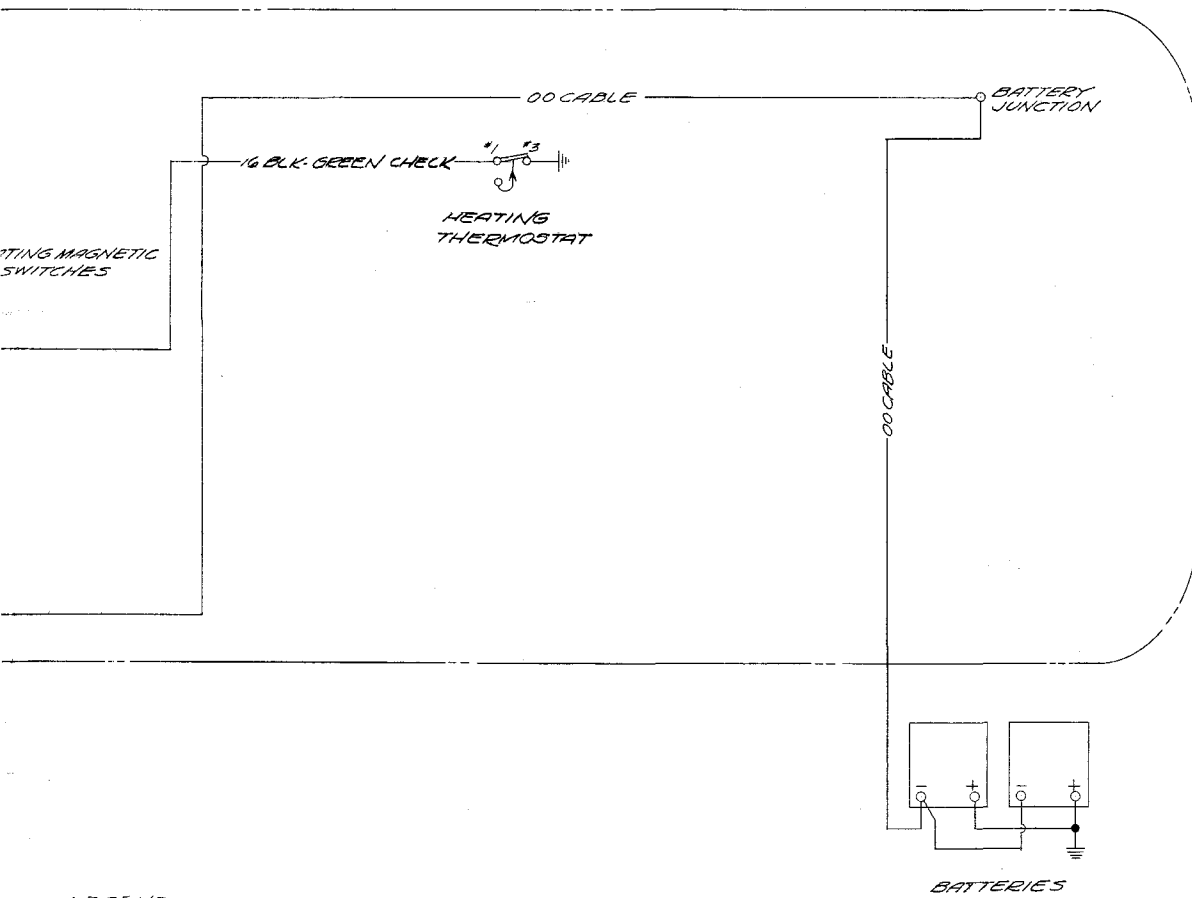
- ENGINE COMPARTMENT JUNCTIONS
- DRIVER'S CONTROL PANEL JUNCTIONS
- BODY JUNCTIONS

TP-6204



1 OF ROTATION WHEN
MOTOR

PTING MAGNETIC
SWITCHES



LEGEND

DRIVERS CONTROL PANEL JCT.

BODY JCT.

tilating Wiring Diagram
Air Conditioning

SERVICE BULLETINS

NOTES

This image shows a single sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

Diesel Engine

Refer to Diesel Engine Maintenance Manual X-5014A for Complete Engine Overhaul Procedures.

This engine section contains general information on tune-up procedures and minor service operations necessary in connection with maintenance of power plant and accessories. Reference to current Diesel Engine Maintenance Manual is made for detailed procedures for performing major service operations. Also included is a description of engine mountings and procedure for replacing power plant assembly.

Instructions covering operation and maintenance

of fuel system items, cooling system items, and electrical units are covered in respective sections of this manual.

DESCRIPTION

Engine is six-cylinder, two cycle, GM Series 71. Additional engine data is included in Specifications at end of this section. Transmission and clutch are attached directly to engine to comprise a unit power plant.

Engine Tune-up

Results obtained from an engine tune-up may be unsatisfactory if a "hit and miss" method is used instead of a systematic approach to the job; therefore, the logical solution is a complete check-up following the cycle in the accompanying illustration and carrying out each step as directed below.

NOTE: Before tune-up procedure is started it is important that air cleaner is serviced as instructed in its respective section of this manual, also crankcase breather tube and air box drains must be clean and unobstructed. Air box drains may be cleaned with compressed air.

CAUTION: Remove or at least loosen an air box hand hole cover, else blower or end plate gaskets may be damaged by excessive air pressure.

Reference should be made to "Trouble Shooting" in current Diesel Engine Maintenance Manual.

COMPRESSION TEST

Compression test is beneficial in determining the need of internal repairs before tune-up procedures are accomplished. This test will indicate condition of pistons, rings, and valve mechanism.

For instructions on how to perform compression test, refer to current Diesel Engine Maintenance Manual.

TUNE-UP SEQUENCE (Refer to Fig. 1)

Following is a sequence in which tune-up operations **MUST** be performed:

1. Adjust exhaust valve clearance.
2. Set fuel injector timing.
3. Set governor spring plunger gap.
4. Position injector rack control levers.
5. Adjust engine idle speed.
6. Adjust governor buffer spring screw.

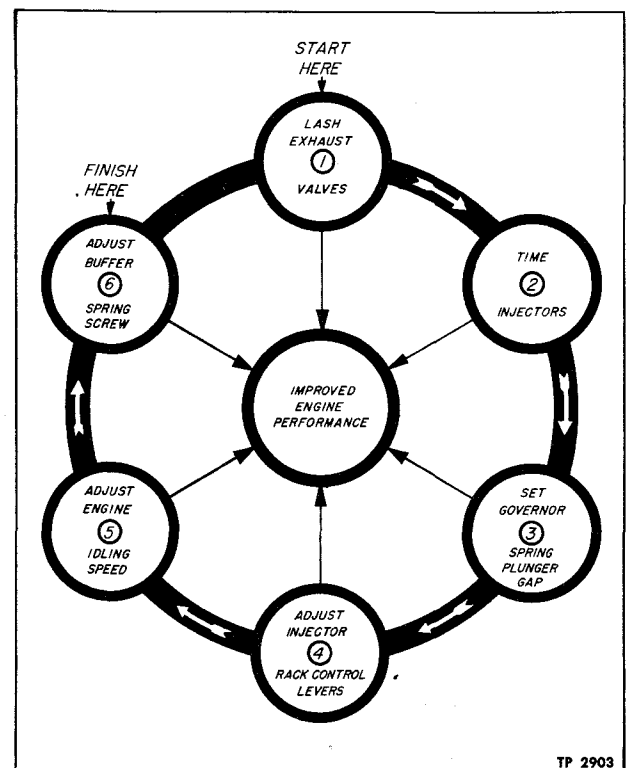


Figure 1—Engine Tune-Up Chart

DIESEL ENGINE ACCESSORIES

Diesel Engine Accessories

Units described herein are used either as standard or special equipment on coaches covered by this manual.

OIL PRESSURE GAUGE

Oil pressure gauge system consists of two electrically connected units; an engine sending unit connected to engine pressure lubrication system and a registering gauge mounted in instrument panel. Oil pressure gauge system is interconnected with control switch so that system is inoperative when switch is in "OFF" position. Refer to ALARM AND SIGNAL wiring diagram in back of manual for electrical circuit.

A mechanical pressure gauge is mounted at oil manifold in engine compartment for use when working on engine.

TESTS

If oil pressure gauge does not operate, or shows apparent false readings, with control switch in "RUN" position, check system as follows:

1. Disconnect wire from terminal at sending unit mounted on bulkhead in engine compartment, then connect 12-volt test lamp between terminal on starter solenoid and body of sending unit. If lamp fails to light, sending unit is not properly grounded.
2. Remove sending unit and check for paint or compound on threads which would prevent proper grounding of sending unit body.
3. After making sure sending unit is properly grounded, touch lead from test lamp to terminal on sending unit. If lamp lights, sending unit is defective and must be replaced. If lamp does not light, remove test lamp and attach regular wire to terminal on sending unit.
4. Test wiring for current flow using test lamp as follows:
 - a. Test wire from control switch to resistor at gauge unit first. If current flows to resistor, check to see if current is reaching terminal at gauge unit. Replace resistor or wiring if no current is flowing to gauge.
 - b. If current flows to both terminals on gauge but gauge does not function when engine is started, check wiring from gauge unit to engine sending unit in engine compartment. When one lead from lamp is attached to terminal on sending unit and other lead is grounded, the lamp should burn.
5. If system still fails to function but mechanical unit in engine compartment shows pressure in engine lubricating system, the trouble must be in actuating element of engine or gauge units or

both units. Replacing the defective unit will correct the difficulty.

6. Do not attempt to repair either unit. When installing new engine unit do not use compound on threads as this will cause increased electrical resistance of unit with resultant faulty gauge reading.

LOW OIL PRESSURE SWITCH

Low oil pressure electrical switch is installed in oil pressure sending manifold, which is mounted on engine compartment bulkhead near surge tank. Manifold is connected with engine oiling system by a flexible tube.

When engine is running, the oil pressure acts upon a diaphragm to hold a pair of switch contacts open. However, if pressure should drop below 3 and 4 lbs., points will close completing circuit. When points close, telltale alarm buzzer sounds, and low oil telltale light illuminates. Whenever alarm buzzer sounds or low oil telltale lights, stop engine immediately and correct cause of low pressure.

CIRCUIT TEST

Low oil pressure indicating system is interconnected with control switch so that system is inoperative when control switch is off.

With control switch in "RUN" position, and engine not running, low oil pressure telltale light should be illuminated and buzzer should sound. If buzzer sounds and light does not illuminate, replace bulb. If light is illuminated and buzzer does not sound, check telltale alarm buzzer.

If light fails to illuminate and buzzer fails to sound with control switch in "RUN" position, momentarily short the two wire terminals at pressure switch. Failure of telltale lights or buzzer to sound indicates that the circuit to these units is at fault. Refer to ALARM AND SIGNAL wiring diagram in back of manual for electrical circuit.

LUBRICATING OIL STRAINER AND FILTER

Diesel engine used in vehicles covered by this book are equipped with a cleanable type oil strainer and a replaceable, non-cleanable, element type filter.

OIL STRAINER

The oil strainer, illustrated in figure 2, incorporates a cleanable type element through which all the oil leaving the oil pump passes. Strainer removes all particles larger than .005" in diameter.

DIESEL ENGINE ACCESSORIES

Strainer element must be thoroughly cleaned at each oil change. If strainer is not cleaned it will eventually become restricted or even clogged; then flow of oil is by-passed around strainer and oil cooler as well. Under these conditions oil will not be strained or cooled and serious damage to engine may result.

CLEANING OIL STRAINER

1. Remove strainer drain plug and allow oil to drain from strainer.
2. Unscrew oil strainer through-bolt then lift off strainer housing and element.
3. Wash inner and outer surfaces of element in clean fuel oil, or other suitable cleaning fluid, using a fine bristle brush. Do not use a wire brush. Be sure element is thoroughly cleaned.
4. Wash other strainer parts as well, making certain all parts of the strainer are clean before reassembling unit, also that gaskets at either end of housing are in place and in good condition.

OIL FILTER

The oil filter illustrated in figure 3, incorporates two replaceable, non-cleanable filtering elements through which only a metered portion of the circulated oil passes. This filter removes abrasive matter, sludge, wax, and other substances detrimental to the engine. Filter elements must be discarded and replaced with new elements at each oil change; otherwise the new oil will become contaminated, and eventually flow of oil through filter will cease resulting in possible serious damage to engine.

CLEANING OIL FILTER

1. Remove filter drain plug and allow oil to drain from filter.

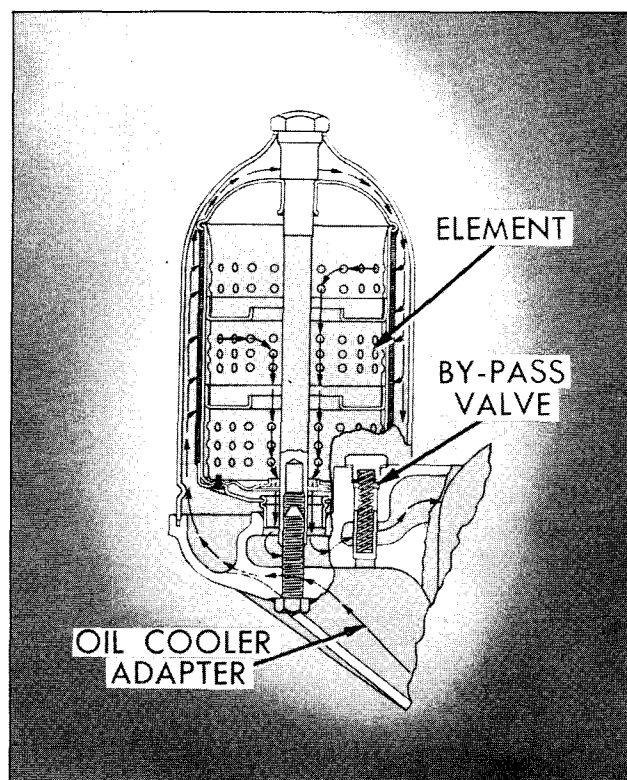


Figure 2—Sectional View of Oil Strainer

2. Unscrew oil filter through bolt, then lift off filter housing and elements. Discard elements,
3. Wash filter parts in clean fuel oil or other suitable cleaning fluid.
4. Install new elements and make certain all parts of the filter are clean before reassembling unit, also that gaskets at either end of housing are in place and in good condition.

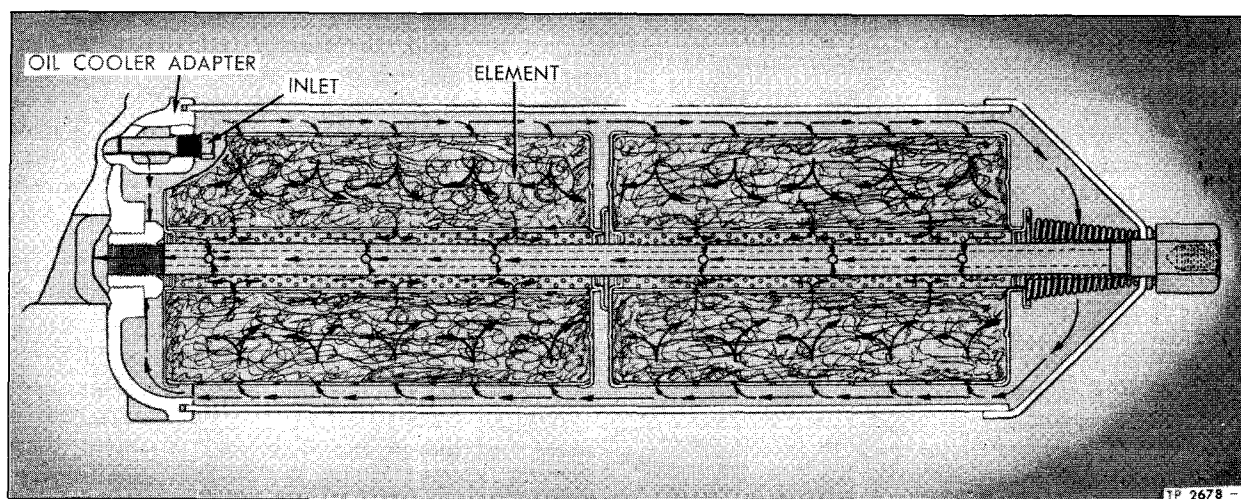


Figure 3—Sectional View of Oil Filter

DIESEL ENGINE ACCESSORIES

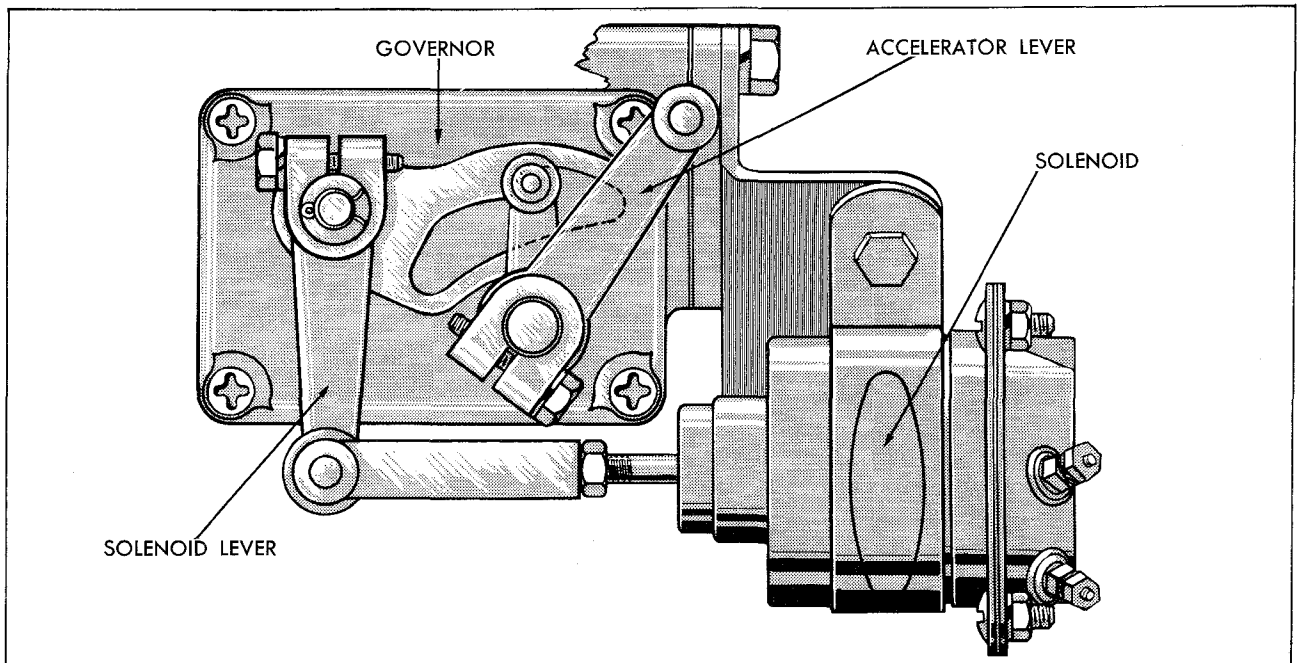


Figure 4—Engine Stop Solenoid and Mechanism

SOLENOIDS

All engines are equipped with an emergency stop solenoid mounted on blower intake. An engine stop solenoid (fig. 4) is also used as standard equipment, however; latter solenoid is not used on coaches equipped with air operated injector rack shut-off (fig. 5).

ENGINE STOP SOLENOID (Fig. 4)

Engine stop solenoid is mounted on engine governor housing and connected by linkage to governor cam lever. When energized by engine stop switch, the solenoid pulls on lever which operates cam and allows spring on accelerator cross shaft to move accelerator lever to "No-Fuel" position.

EMERGENCY STOP SOLENOID

Emergency stop solenoid, mounted on blower intake, is used to release a valve to shut off air supply to engine, thereby stopping the engine. Solenoid is energized by emergency stop button at instrument panel. Energized solenoid acts to release a valve which is forced into closed position by spring.

NOTE: After stopping engine by means of emergency stop solenoid, the engine cannot be started again until valve is opened and reset manually.

SOLENOID MAINTENANCE

Solenoids require no maintenance other than

keeping contact points and terminals clean and tight. Always check action of solenoid if it has been removed and reinstalled. If unit fails to function, first check switches, relay (when used) and wiring before working on solenoid. Only test to make on solenoids is to check pull of solenoid coils with suitable equipment. Refer to "Specifications" later in this section for test data.

AIR OPERATED INJECTOR RACK SHUT-OFF

Injector rack shut-off, operated by an air cylinder, is used as special equipment on some coaches. Figure 5 shows air cylinder and linkage installation. Air supply is controlled by magnet type valve which is energized from engine control switch circuit. Air cylinder is bolted in place at engine cylinder head, and adjustable rod transmits piston movement to lever installed on end of injector control tube.

When engine control switch is in "RUN" position, air pressure is exhausted from air cylinder permitting injector racks to be moved to "full fuel" position for normal operation. When control switch is turned off air is admitted to air cylinder and piston moves to end of travel thereby forcing injector racks to "No-fuel" position causing engine to stop. Air is applied to cylinder during the time control switch remains in off position.

DIESEL ENGINE MOUNTING

MAINTENANCE

The only maintenance normally required at shut-off mechanism is a periodical check of push rod adjustment and check of air line connections.

AIR INJECTOR SHUT-OFF AND MOTO-GARD

Refer to wiring diagram in back of manual for circuits which control shut-off valve.

AIR CYLINDER PUSH ROD ADJUSTMENT

(Fig. 5)

1. Check air cylinder mounting bolts which must be tight.

2. Remove cylinder head cover and check for clearance between push rod and cylinder head stud nut. If any interference exists, loosen lock nut, turn rod as necessary to obtain clearance between rod and nut.

3. With engine stopped and control switch in "RUN" position, hold injector control tube in "full-fuel" position and check for clearance between pin and throat of rod yoke. If necessary, turn rod end coupling to provide 1/16 inch clearance, then tighten lock nuts.

4. Turn control switch off. If there is pressure in air system, piston will move inward to end of travel and push injector racks to "no-fuel" position.

With air cylinder in this position, pin (fig. 5) should not bind on yoke and end of yoke must not interfere with cylinder head.

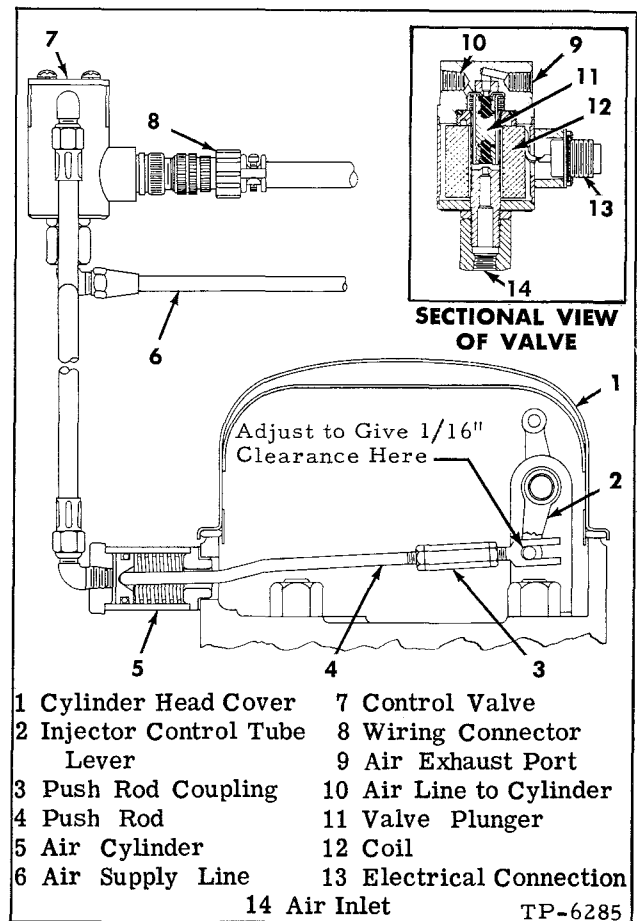


Figure 5—Air-Operated Injector Shut-Off

Engine Mounting

Diesel power plant including engine, clutch and transmission is mounted transversely on engine support cradle and is supported by a three point rubber mounting. Front mounting is trunnion type, while rear mounting is two point cradle type. Refer to figure 6.

Engine cradle is supported at engine bulkhead-brackets, and by two support tube and plate assemblies which are attached to engine support beam. Struts from engine compartment bulkhead to rear spring rear brackets, transfer shock loads to spring brackets.

Engine is held firmly in position on rear mountings by stabilizer tubes (C) installed as shown in figure 6.

Engine, clutch, transmission, together with radiator and exhaust system are assembled forming a unit power plant. The complete unit may be quickly removed with engine dolly. Refer to figure 7.

Power plant and accessories are accessible

for minor service operations through rear and right-hand compartment doors. Transmission may also be removed as a unit, independent of engine, to perform service operations on clutch or transmission. Refer to Sections 5 and 17 for procedures on the above two units.

Engine compartment switch panel, accessible through rear compartment door, contains starter button, starter circuit cut-out switch, and engine compartment light switch. Always shut off starter circuit cut-out switch before working on engine. This prevents accidental starting of engine with starter button, while working on engine.

REMOVING POWER PLANT

Power plant, including transmission and radiator, may be removed from vehicle in following manner: Procedures outlined are in sequence and should be followed in order. Refer to figures 6 and 7.

NOTE: Before proceeding with opera-

DIESEL ENGINE MOUNTING

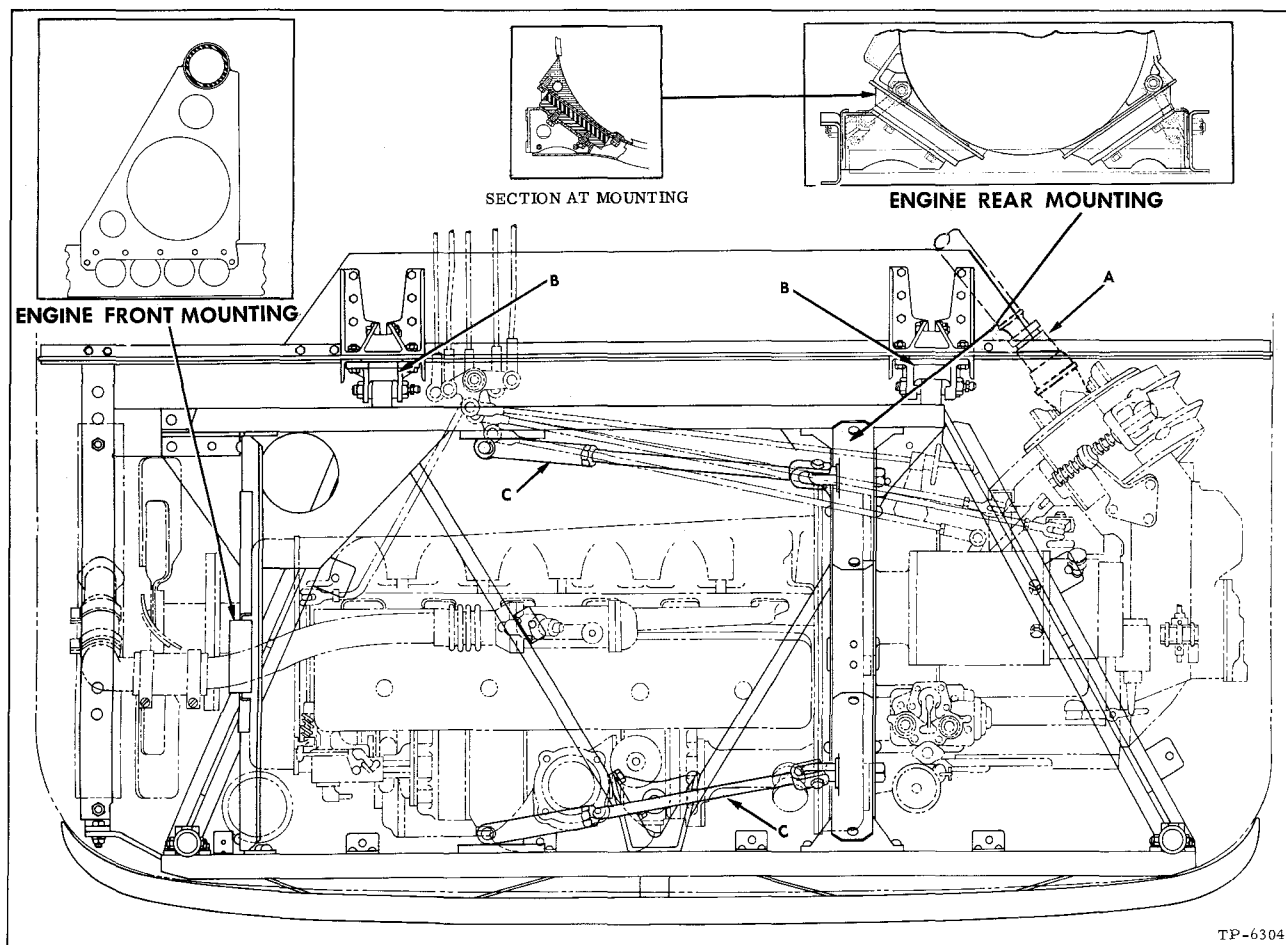


Figure 6—Power Plant Mounting

tions as listed, disconnect both battery leads.

1. Raise and support engine compartment door, then remove door support arms at rear quarter panel brackets.

2. Remove engine rear enclosure panel.

3. Shut off engine compartment starter circuit cut-out switch.

4. Remove transmission and engine dust pans.

5. Drain cooling system. Two drain cocks must be opened; one at water pump and one under forward radiator water outlet line. Shut-off valves in heater lines may be closed so it will not be necessary to wait for water to drain from heating system.

6. Disconnect heater pipes between engine and bulkhead; cooling system between radiator and surge tank; air intake system between blower and manifold, also generator; compressed air system as necessary; electrical system, exhaust

system; hand brake, transmission, clutch, and accelerator control rods; fuel lines and speedometer cable.

7. Unscrew propeller shaft slip joint (A, Fig. 6). When engine is removed, propeller shaft will separate at joint.

8. Place suitable dolly under engine.

9. Remove bolts (B) retaining bracket cap ball joint to engine bulkhead support bracket.

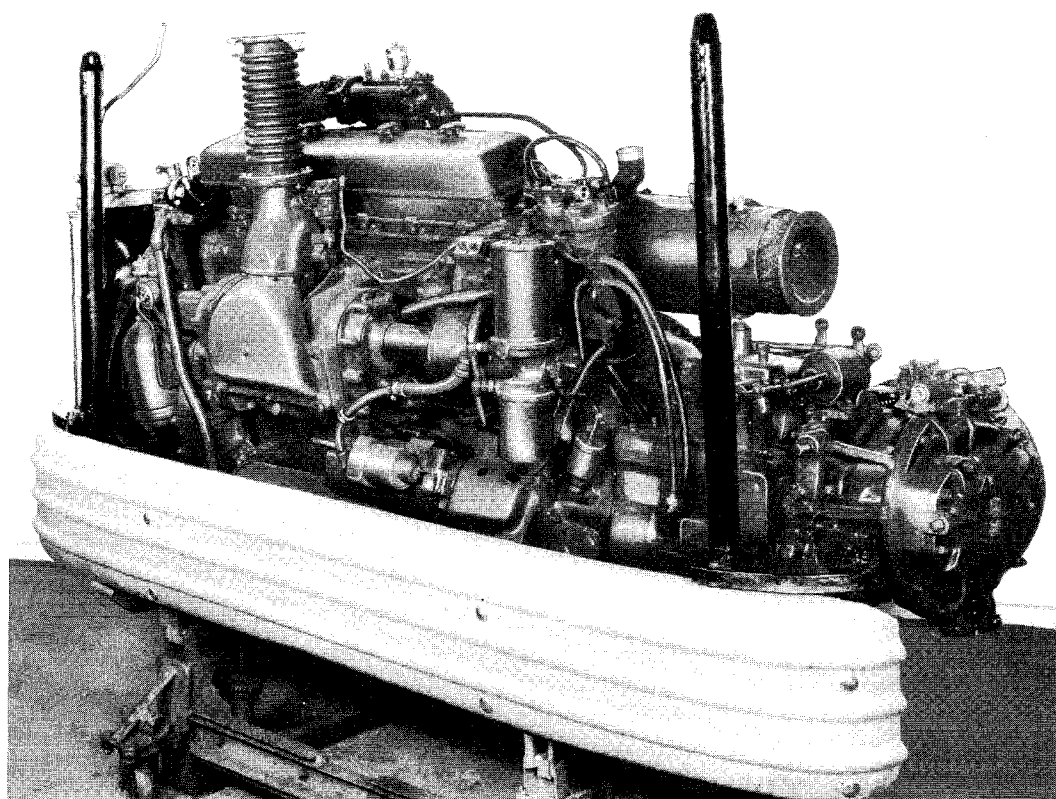
10. Remove bolts retaining right- and left-hand support tube assemblies to engine support beam assembly.

11. Remove screws retaining engine rear quarter panels to engine support beam.

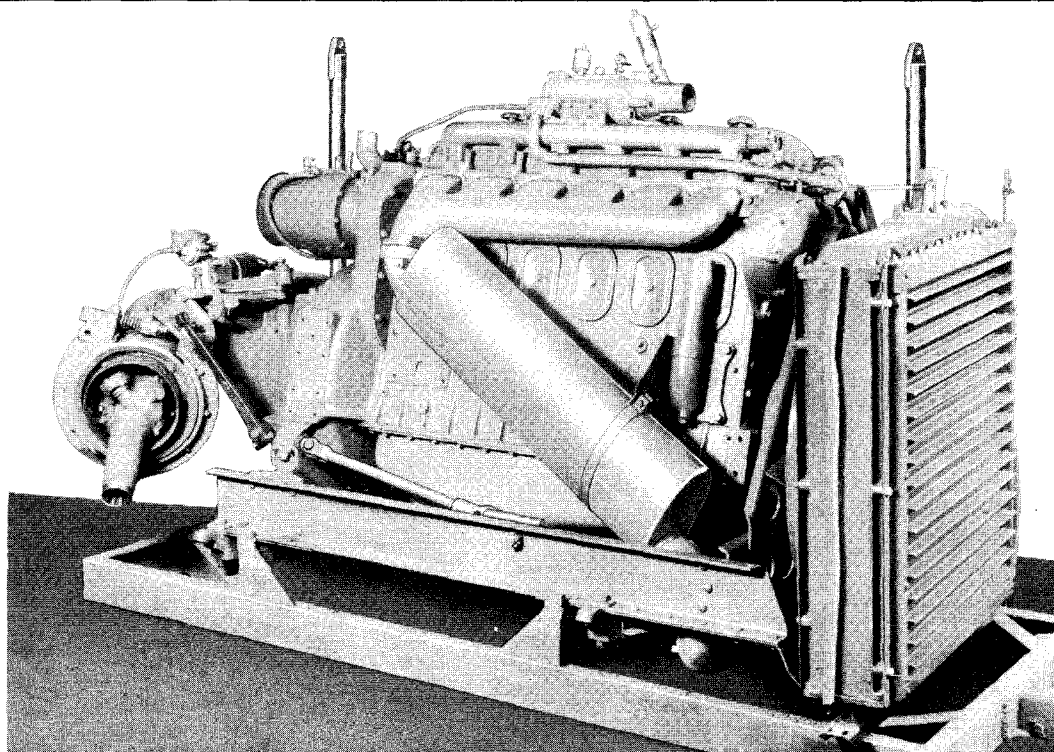
12. Remove two bolts retaining radiator support channel at front edge of engine bulkhead.

13. Recheck carefully to be sure that all apparatus from engine to chassis has been disconnected; then withdraw engine cradle assembly with radiator, engine and transmission as a unit from rear of vehicle.

DIESEL ENGINE MOUNTING



RIGHT SIDE VIEW



LEFT SIDE VIEW

TP-6305

Figure 7—Power Plant Removed

DIESEL ENGINE SPECIFICATIONS

SPECIFICATIONS

ENGINE DATA

Model	6-71LA39
Bore	4-1/4"
Stroke	5"
Total Displacement - Cu. In.	425.6
Rotation	Counterclockwise
Firing Order	1-4-2-6-3-5
Engine Governed Speed (no load)	2100 rpm

LOW OIL PRESSURE SWITCH

Make	AC
Model	1506714
Contacts Break (Lbs. Pressure)	2 - 4

OIL PRESSURE GAUGE ON INSTRUMENT PANEL

Make	AC
Type	G
Gauge Unit No.	1507319
Engine Unit No.	1506191
Voltage	6
Range	0 - 60 Lbs.

ENGINE STOP SOLENOID AND EMERGENCY STOP SOLENOID

Make	Delco-Remy
Model	001424
Voltage	12
Current Consumption @ 80 F.	12 - 13 Amps.

Fuel System

Description and maintenance of the Diesel fuel injector system, fuel oil pump, fuel oil manifolds, blower, and governor are contained in separate maintenance manual for GM Series 71 Diesel Engine, Form X-5014A.

FUEL OIL SYSTEM MAINTENANCE

It is important that fuel oil is clean and free from water to assure efficient engine operation. When storing and dispensing fuel oils, it must be handled as described under "Fuel Oil Storage and Handling" later in this section.

FUEL OIL FILTERS

Two fuel oil filters, mounted to a common bracket on the engine (fig. 1), are provided to keep the fuel oil clean and free from water as it enters the injector. Two small filters are also provided in each injector.

The primary or lower of the two fuel oil filters is a cleanable (edge-type strainer) filter and is designed to remove the larger particles of solid foreign matter and any water which may accumulate.

The secondary or upper filter is a removable element (absorption) type, and is designed to remove all of the solid foreign matter that may have passed through the edge type strainer.

CARE OF FUEL OIL FILTERS

In order for these filters to clean the fuel oil it is important that they are given proper care. Service in the following manner:

Primary Filter (Cleanable Type)

Primary filter (fig. 1) must be drained frequently because if water is present in the fuel it is most likely to accumulate in this filter. No definite draining periods can be given here, inasmuch as the necessity for draining depends upon the cleanliness of the fuel put into the fuel tank. It is recommended, that a small amount of fuel oil be drained from this filter daily, noting the water content (if any), then from this experience definite draining periods may be established. Drain filter by opening drain cock at bottom of filter. If water in any amount is regularly found in this filter, it is an indication that something is wrong in the method of handling and storing of the fuel oil and a thorough investigation must be made to

eliminate the trouble; then the fuel tank lines and both filters drained and cleaned. The only water that will normally accumulate in the fuel system is from condensation in the fuel tank.

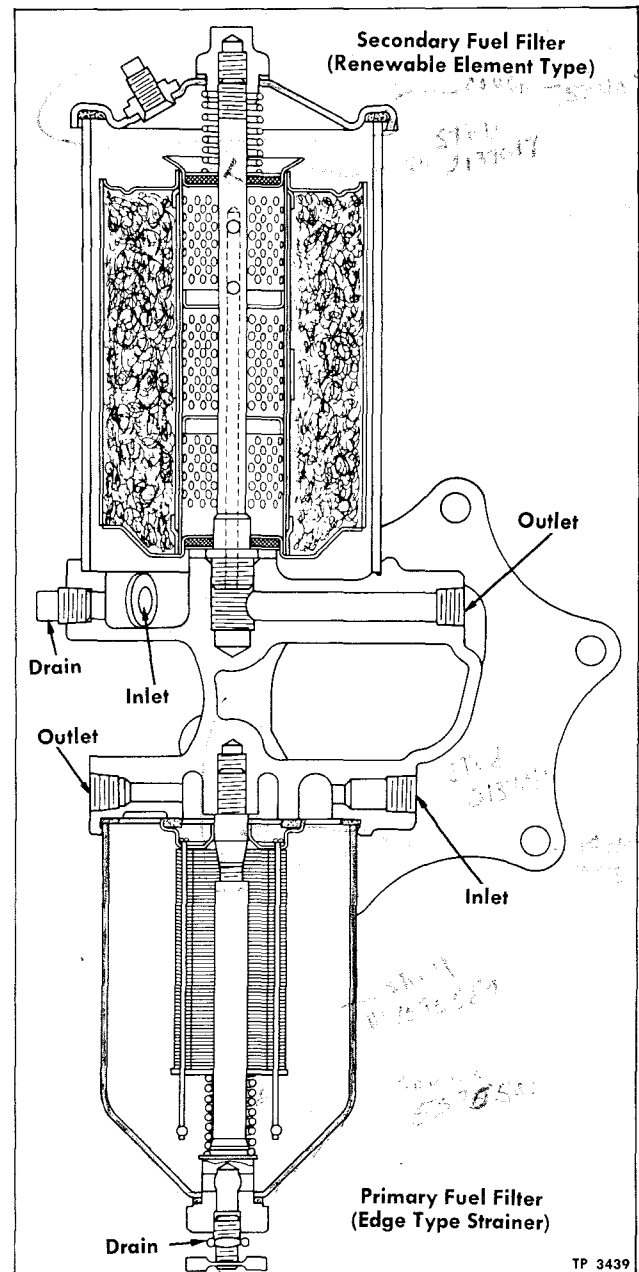


Figure 1—Fuel Filter Installation

FUEL SYSTEM

Cleaning Primary Filter

In addition to periodic draining as described in preceding paragraph, filter should be thoroughly cleaned every 5000 miles as follows:

1. Open drain cock at bottom of filter and allow filter to drain.
2. Unscrew through bolt (at bottom of filter), withdraw housing and edge-type filter element.
3. Wash all filter parts, including strainer element, in a suitable cleaning solvent. Be sure all particles are removed from between disks of element. Use air if necessary.
4. Inspect filter housing gasket, element gasket, and through bolt gasket; replace if not in good condition.
5. Reassemble filter and inspect carefully for leaks. Be sure drain cock is closed tightly.

Secondary Filter Renewable Element Type

It is recommended that secondary filter (fig. 1) be drained at same intervals as primary filter. Refer to "Primary Filter" in previous paragraph for intervals.

In addition to draining, the following check should be made at intervals of 1500 to 2000 miles to determine the condition of the element. This check may be made by removing the pipe on the outlet side of the filter and installing a pressure gauge connected to a "tee." Start engine and note pressure on gauge. When the pressure reading is reduced to 15 lbs. at 2000 rpm, the element must be removed and replaced. Do not open the filter except at time of element replacement. Replacement usually will be required every 10,000 miles or 500 hours. **DO NOT ATTEMPT TO REMOVE AND CLEAN FILTER ELEMENT.**

Replacing Secondary Filter Element

If periodic check, as described in previous paragraph, indicates filter element should be changed, proceed in following manner:

1. Remove drain plug from filter housing and allow filter to drain.
2. Loosen cover nut, then lift cover and gasket from filter housing.
3. Lift element from filter housing and discard element.
4. Wash all filter parts with a suitable solvent.
5. Install new element in housing and install cover, using a new gasket between cover and housing. Tighten cover nut and drain plug.
6. **CAUTION:** After element has been replaced as instructed above, loosen, but do not remove the square headed plug at top of filter for air vent. Loosen it just enough to allow air to escape. **THEN**, run the engine until fuel oil comes out of this vent in a solid stream. Check the filter connections and oil lines for leaks and tighten if necessary.

ACCELERATOR PEDAL AND LINKAGE

Accelerator pedal is connected to governor by means of rods, linkage and return springs. Adjustable yokes are provided at front and rear end of control rod and at cross shaft at front of engine, to adjust length of rods.

On coaches equipped with engine stop solenoid, the accelerator pedal must be pressed to release injector racks from "no-fuel" position before engine can be started.

FUEL TANK AND LINES

Fuel tank is mounted as illustrated in figure 2. Fuel filler neck is accessible in compartment on right-hand side of coach body. Fuel line connections are accessible through access door at rear of tank, also through filler neck door.

An additional fuel tank is sometimes used as special equipment in which case a valve is provided which makes it possible to draw fuel from either tank or from both tanks at same time. Valve is located in rear tank compartment near filler cap.

Fuel tank on some vehicles is equipped with fuel screen, illustrated in figure 3, which is installed in fuel outlet flange and extends down into stand pipe of tank. Screen must be removed and cleaned periodically. Removal of screen may be accomplished by removing hex plug at top of flange to which screen is attached.

Fuel feed and return lines are special metal tubing or flexible tubing. Metal lines are protected where necessary with loom and are securely clipped in place.

INSPECTION

Tank mountings must be checked regularly and tightened if necessary. Line connections must be checked periodically for leaks. Also be sure drain plug in fuel tank is tightened firmly.

FUEL FILLER SIGNAL

Fuel tank is equipped with a signaling device which emits a whistling sound which can be heard by attendant. Whistle starts shortly after starting to fill tank and continues until fuel reaches "full" level. **FILL ONLY WHILE WHISTLE BLOWS.** Do not fill tank after whistle stops.

AIR INTAKE SYSTEM

Air for engine is taken in through screened openings at right and left rear quarter panel window above engine compartment. Air passes through compartment at rear of rear seat into silencer

FUEL SYSTEM

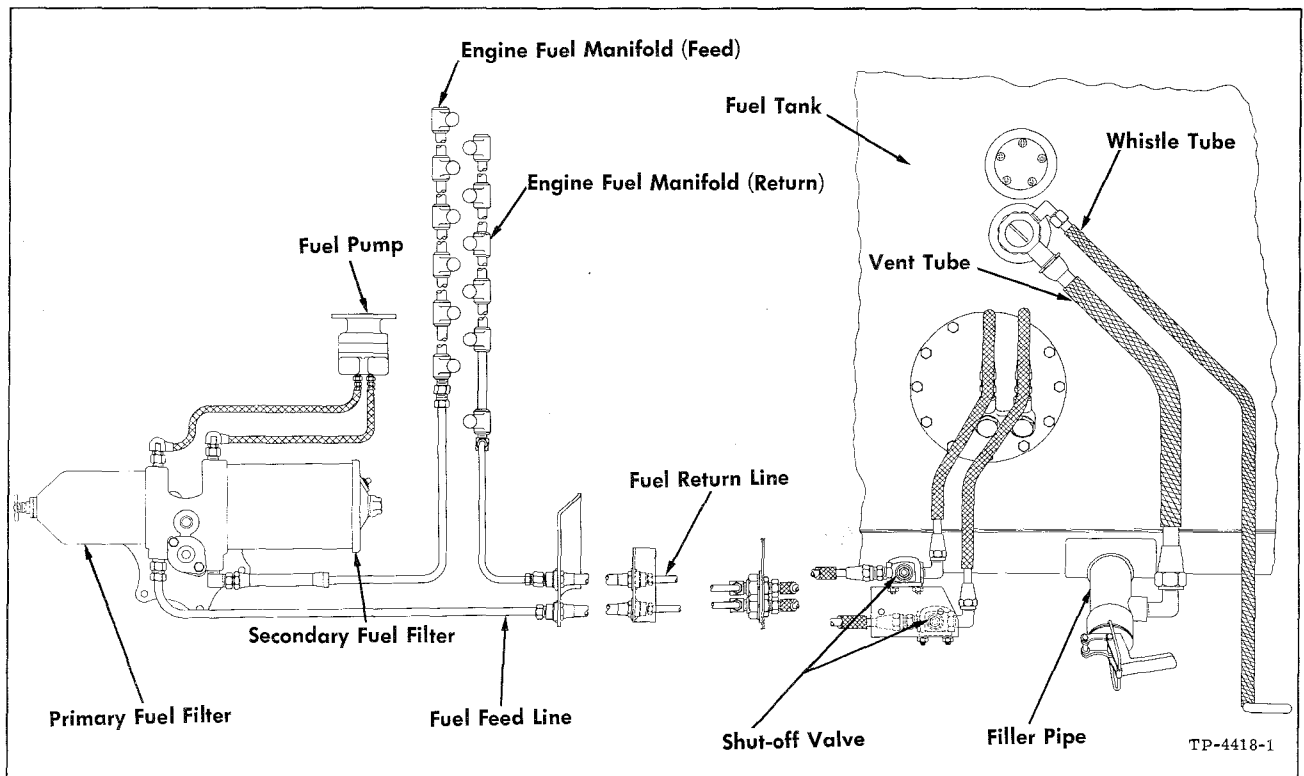


Figure 2—Fuel Tank and Lines

then through air cleaners to engine blower as shown in figure 4.

AIR CLEANERS

Three heavy duty oil bath air cleaners are mounted to manifold located at bottom of silencer and are accessible through engine compartment doors. Cross section of air cleaner is shown in figure 5.

Each air cleaner is equipped with an oil reservoir which is easily removed for servicing. Filter element can be removed for cleaning.

SERVICING AIR CLEANERS

Importance of keeping air cleaners in proper condition should be impressed on those responsible for mechanical upkeep of engine.

Unless air cleaners are cleaned periodically as service conditions require, they will not function properly, and in some instances, actually aggravate the condition which they are designed to prevent. If air cleaner is allowed to become clogged with dirt, and left in that condition, flow of air to blower will become restricted, thus causing increased fuel consumption, engine heating up, crankcase dilution, and otherwise affecting performance of engine.

For those reasons, air cleaner must be cleaned at regular intervals at least every 1,000 miles, or

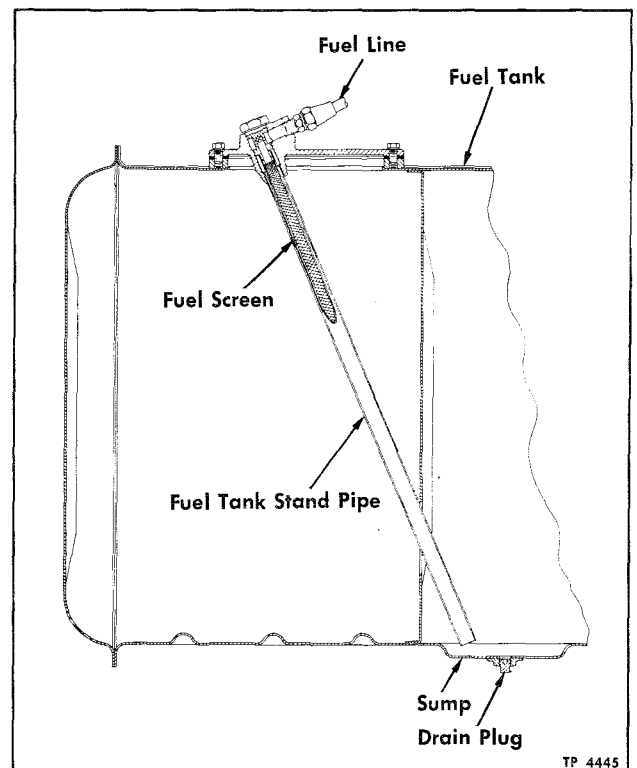


Figure 3—Fuel Tank Fuel Screen

FUEL SYSTEM

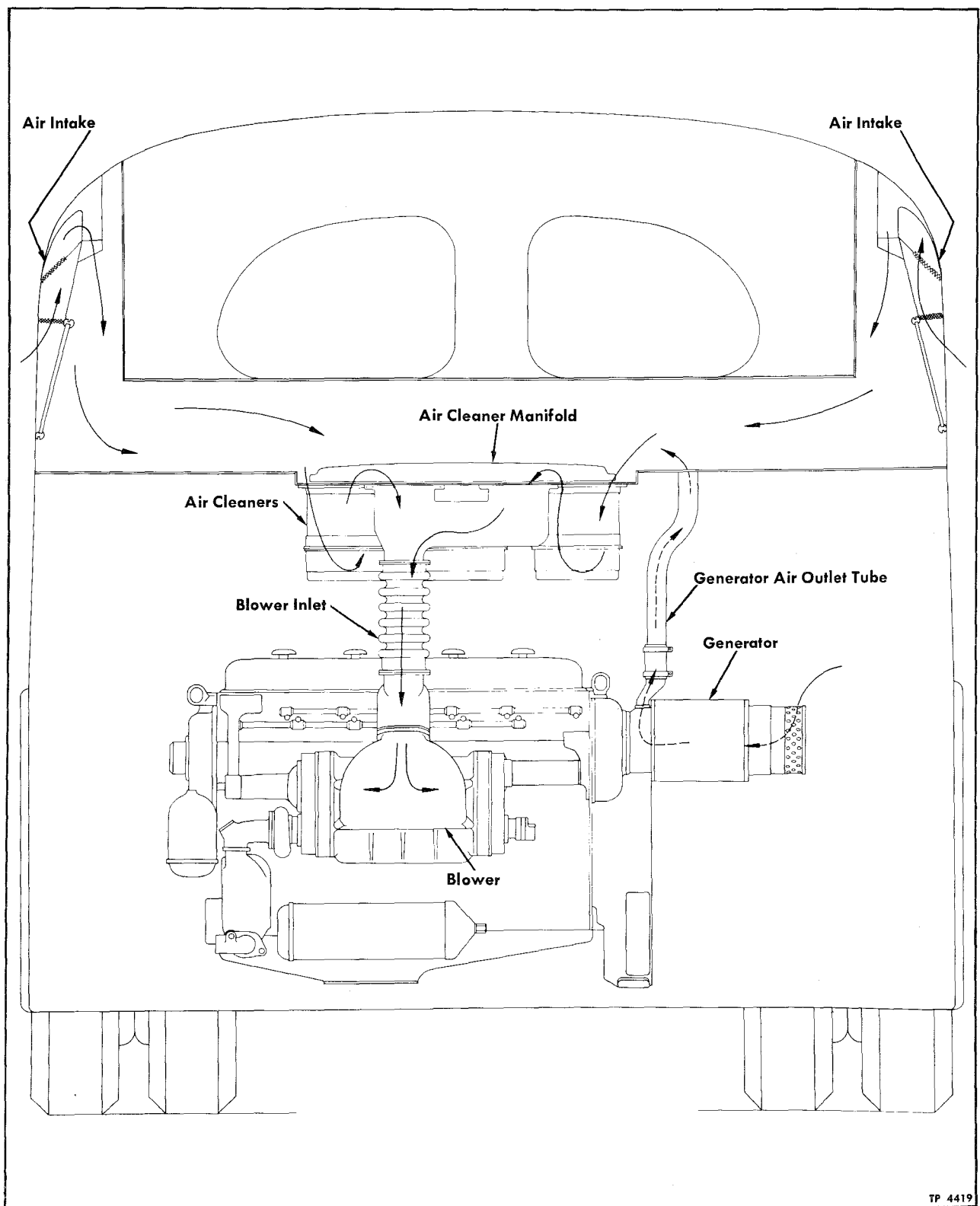


Figure 4—Air Intake System

FUEL SYSTEM

more often if conditions warrant. Under adverse conditions or extensive operation on dusty or sandy roads, units should be cleaned every day or at least every 200 miles.

Air cleaners on vehicles operating in dust storm areas should be cleaned immediately after such storms occur.

CLEANING AIR CLEANER

Oil bath air cleaner must be cleaned in the following manner:

1. Loosen the two retaining clamps (one on each side) that retain the oil sump assembly to air cleaner outer shell. Remove sump.
2. Remove filter element from inner shell.
3. Clean filter element by plunging in clean gasoline or other suitable cleaning fluid until entirely clean.
4. Allow element to dry. **DO NOT BLOW DRY WITH COMPRESSED AIR.**
5. Clean out oil sump thoroughly, then fill it to proper level with clean engine oil as shown in LUBRICATION (SEC. 13). In the event oil becomes congealed due to cold weather, flush and refill with a lighter oil.
6. Air passage between inner and outer cleaner shell may be cleaned by removing attaching screws at cleaner manifold.
7. Assemble parts to cleaner by placing filter element in position in inner cleaner shell, then sump with oil at proper level into position on outer cleaner shell.

Engage clamp securing sump to outer shell to complete assembly. NOTE: Seal between sump

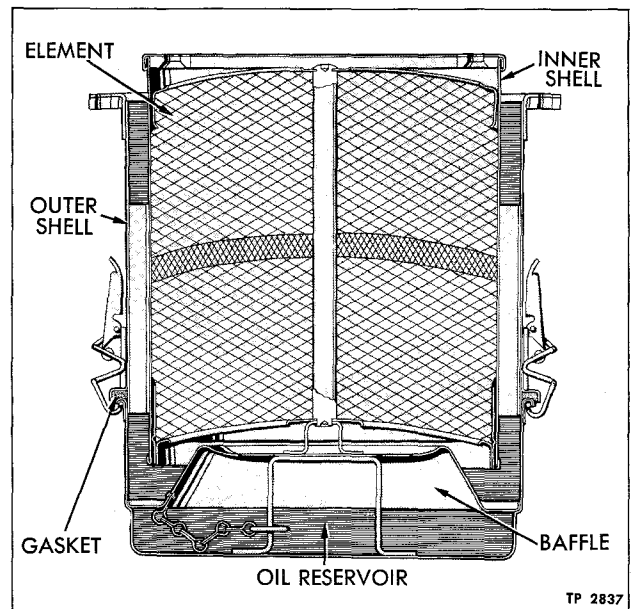


Figure 5—Sectional View of Air Cleaner

and outer cleaner shell must be in good condition or be replaced.

CLEANING AIR INTAKE SCREENS

Screens at air intake openings above rear quarter windows should be inspected periodically for accumulations of foreign material. If screens are found to be dirty, retainers can be removed after which screens can be taken out and cleaned.

SPECIFICATIONS

FUEL FILTER

Primary (Lower)

Make AC
Type TL-12

Secondary (Upper)

Make AC
Type (Element) T-14

AIR CLEANERS

Make AC
Type Oil Bath

FUEL TANK

Capacity (Gals.) 100

FUEL INJECTORS

FUEL PUMP

GOVERNOR

BLOWER

Refer to current Diesel Engine Maintenance Manual for information.

IMPORTANT: Refer to following page for Fuel Specifications.

FUEL SYSTEM

FUEL SPECIFICATIONS

It is recommended that only completely distilled fuel oil be used, because residual (undistilled) fuel oil contains high amounts of sediment and sulphur.

The fuel oil specifications given in chart below are the only specifications which apply to fuel to be used in GM parlor coach Diesel engines.

FUEL SPECIFICATIONS CHART

DIESEL FUEL SPECIFICATIONS FOR PARLOR COACHES (INTERCITY OPERATION)

PROPERTY	REQUIREMENT	ASTM TEST METHOD NO.
Cetane No.	45 Minimum	D 613
Pour Point	Max. 10°F. below lowest expected temperature.	D 97
Flash Point	120°F. Minimum	D 93
Volatility:		
Initial Condensed	320 F. Minimum (Note 1)	
90% Condensed	550 F. Maximum	
End Point	600 F. Maximum	D 158 (Note 2)
SU Viscosity 100 F.	30-40 Maximum	D 445 & D 446
Water & Sediment	0.05% Maximum	D 96
Ash	0.01% Maximum	D 482
Total Sulphur	0.5% Maximum	D 129
Corrosive Sulphur	Pass Test	D 130 (Note 3)
Carbon Residue (10% Res.) ..	0.1% Maximum	D 189
Alkali or Mineral Acid	Neutral	D 663 or D 664
Odor	Non-offensive	

Note 1 - Operation under severe conditions in hot weather may necessitate specifying initial condensed point of 335 F. minimum, in order to prevent occurrence of vapor lock and/or irregular idling.

Note 2 - If kerosene or similar fuel is used, Method D 86 applies.

Note 3 - Test should be conducted at 212 F. instead of 122 F.

FUEL OIL STORAGE AND HANDLING

It is important that extreme care be exercised in the handling and storage of Diesel fuel oil. Absolute cleanliness and the absence of water in the fuel oil is essential to satisfactory operation. It is therefore recommended that wherever fuel oil is stored, adequate filtering equipment be provided. It is suggested that the fuel oil be double-filtered from storage tank to pump and that filters are properly serviced according to instructions from the filter manufacturer.

In addition to servicing the filters, proper service of the dispensing system requires that approximately every ten days a hand pump be inserted in lowest portion of storage tank to remove

the accumulated water and sludge. Some layouts will have a sludge collection pan for removal of dirt and water and hand pump will not be needed.

If fuel oil is obtained and stored in drums without the benefit of the above filtering arrangement, it is necessary that extreme caution be used in handling to assure absolute cleanliness. Drum should be provided with a pump which can be screwed or otherwise properly attached to the fuel outlet hole. Pump should be equipped with a good filter, the element of which can be removed and cleaned or replaced.

It is also advisable to provide a suitable dust cover for end of pump hose when not in use.

Lubrication

It is essential that care be exercised in the purchase and application of lubricants.

The application of the right lubricant in the right place at the right time and by the right method will greatly reduce the actual cost of transportation delivered.

THE RIGHT LUBRICANT

In your selection of the proper brand of oil, it is desirable to consider the reputation of the refiner or marketer. He is responsible for the quality of his product and his reputation is the vehicle owner's best indication of quality.

THE RIGHT PLACE

Lubrication fittings or accessible lubrication points have been incorporated on all mechanical units of the vehicle, where lubrication is needed.

THE RIGHT TIME

Intervals at which various points on the chassis should receive attention are indicated on the lubrication chart. Intervals are based upon actual

experience and tests, as well as careful consideration of design and purpose of parts to be lubricated.

THE RIGHT METHOD

The correct application of the lubricant to the various points is essential. Procedures specifically applying to the process of lubricating various units are outlined in the explanatory notes.

When necessary to remove a unit in order to accomplish lubrication, procedures necessary for such removal are shown in applicable sections of the manual.

HOW TO USE THIS LUBRICATION SECTION

The lubrication chart on the following page will locate each lubrication point by a number which corresponds with another chart on page opposite. This chart indicates the item to be lubricated, what lubricant to use, capacity or method of application, recommended interval in miles, and an explanatory note reference. Be sure to refer to each note, as more detailed instructions are given when necessary.

Related Subjects in Other Sections

Refer to all Section in this Manual for Design and Maintenance Information.

Refer to Air Conditioning Manual for type of lubricant, also interval and method of application of lubricants required when vehicle is equipped with air conditioning.

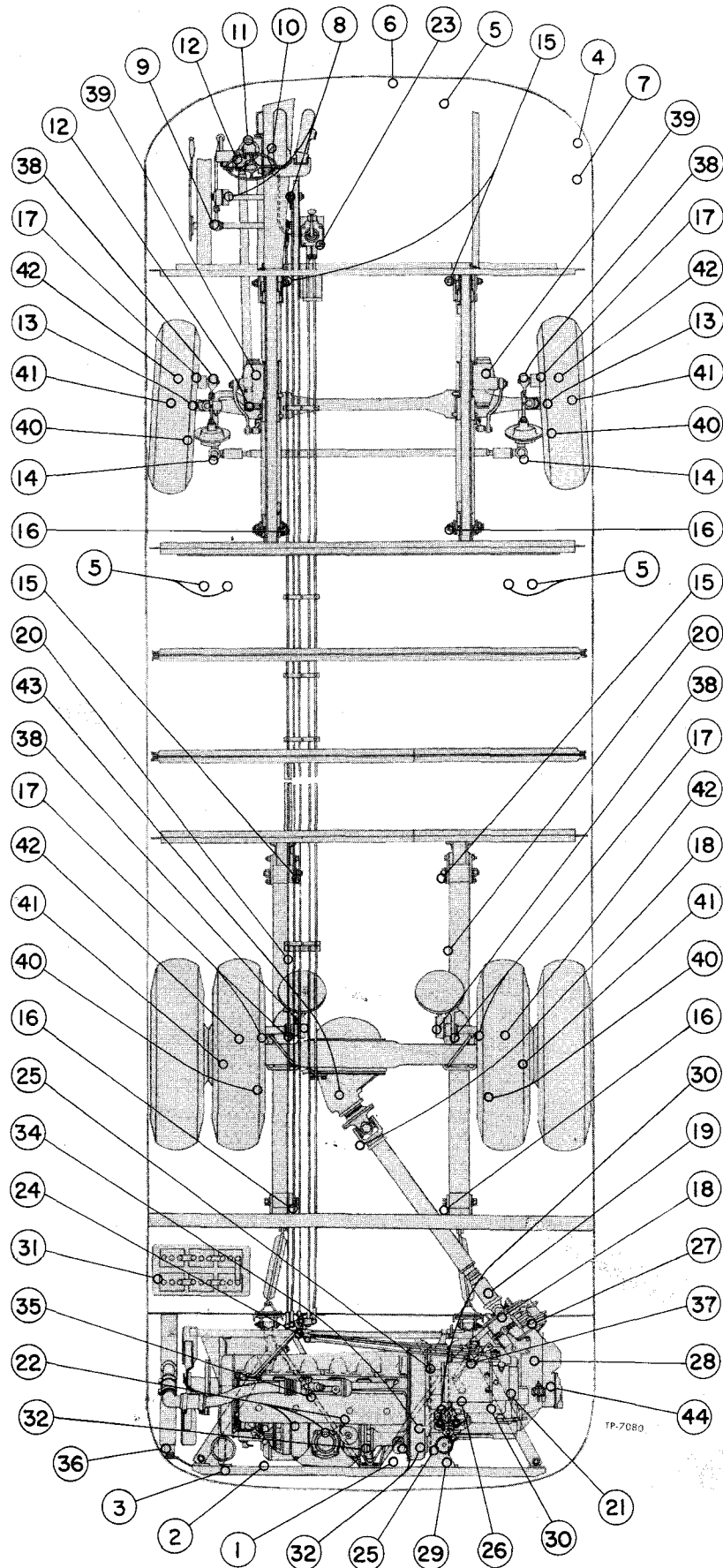
13

LUBRICATION AT ASSEMBLY

In addition to numbered items on chart, which are lubricated at regular intervals, some units used in these vehicles are lubricated only at time of assembly. Refer to the respective section of this manual for "At Assembly" lubrication application instructions, also to note in following tabulation for type of lubricant.

<u>Name</u>	<u>Symbol</u>	<u>Note</u> <u>No.</u>	
Radiator Shutter Linkage	E	1	Refer to Sec. 6
Steering Column Upper Bearing . .	S2	5	Refer to Sec. 16
Clutch Shaft Splines	S5	7	Refer to Sec. 5
Hand Brake Control Rod Loom . .	S18	13	Apply
Clutch Control Rod Loom	S18	13	Apply
Accelerator Control Rod Loom . .	S18	13	Refer to Sec. 12
Transmission Control Rod Loom .	S18	13	Refer to Sec. 17
Brake Application Valve	S3	6	Refer to Sec. 4
Water Pump Bearings	--	--	Sealed Type - Pre-Lubricated

LUBRICATION



LUBRICATION

THE RIGHT LUBRICANT • AT THE RIGHT PLACE • AT THE RIGHT TIME

Item No.	Name	Remarks & Capacities	Miles	Symbol	Note
1	Engine	Keep to Full Mark - *26 Qts. With Std. Filter Equipment	Daily	E	1
2	Oil Filter	Replace Element at Engine Drain	-	E	1
3	Oil Strainer	Clean at Engine Drain	-	E	1
4	Door Hinges	Apply	1,500	E	1
5	Heaters	Five Oil Cups	1,500	E	1
6	Destination Sign Cranks	Apply Sparingly	1,500	C	4
7	Door Control Rod End	One Fitting	1,500	C	4
8	Clutch Control Cross Shaft	Two Fittings	1,500	C	4
9	Clutch Pedal	One Fitting	1,500	C	4
10	Transmission Control Tower	One Fitting	1,500	C	4
11	Steering Gear Housing	One Fitting	1,500	G	3
12	Steering Drag Link Ends	One Fitting Each End	1,500	C	4
13	Steering Knuckles	Two Fittings Each Side	1,500	C	4
14	Steering Tie Rod Ends	One Fitting Each End	1,500	C	4
15	Spring Pins - F. & R.	Two Fittings Each Side	1,500	C	4
16	Spring Shackles - F. & R.	Four Fittings Each Side	1,500	C	4
17	Brake Camshafts - F. & R.	One Front - Two Rear	1,500	C	4
18	Prop. Shaft "U" Joints	One Fitting Each Joint	1,500	G	3
19	Prop. Shaft Slip Joint	One Fitting	1,500	C	4
20	Sway Bar Bushings and Links	Apply - Brush or Spray	1,500	S-12	11
21	Generator Air Cleaner	Wash & Dip in Light Oil	1,500	E	1
22	Blower Air Cleaners (3)	Keep to Level Mark	1,500	E	1
23	Control Rod Linkage	Brush or Spray	1,500	E	1
24	Control Rod Bell Cranks	Two Fittings at Bulkhead	1,500	C	4
25	Clutch Release Shaft Ends	One Fitting Each End	1,500	C	4
26	Hand Brake Bell Crank Idler	One Fitting	1,500	C	4
27	Hand Brake Anchor Pin	Three Fittings	1,500	C	4
28	Speedometer Adapter	One Fitting	1,500	C	4
29	Clutch Release Bearing	One Turn of Grease Cup	1,500	S2	5
30	Generator	One Turn of Each Cup	1,500	S2	5
31	Battery Terminals	Keep Coated	1,500	S3	6
32	Starter	Three Oil Cups	3,000	E	1
34	Clutch Pilot Bearing	Sparingly - Through Temporary Fitting	3,000	S2	5
35	Shutter Thermostat	Disconnect Inlet Line - Inject 1 Oz. Fluid	3,000	S-10	9
36	Shutter Air Cylinder	Remove Plug and Inject 2 Oz. Fluid	3,000	S-11	10
37	Shutter Air Filter	Remove Plug - Inject 1 Oz. Fluid	3,000	S-13	12
38	Slack Adjusters - F. & R.	Through Fittings	1,500	C	4
39	Shock Absorbers (Front)	Fill With Fluid Gun	15,000	S6	8
40	Brake Shoe Anchor Pins	Sparingly Through Temporary Fitting	15,000	S2	5
41	Wheel Bearings - F. & R.	Hand Pack or Use Lubricator Do Not Use Pressure Gun	15,000	S2	5
42	Brake Shoe Roller Pins	Apply Sparingly	15,000	E	1
43	Rear Axle Differential (Fill)	Fill to Level of Filler Plug - 26 Pts.	15,000	G	3
44	Transmission	To Level Mark on Dipstick - 9-1/2 Qts.	15,000	ES	2

*Note: If special oil filters are used, engine oil capacity will vary. Check dipstick mark.

LUBRICATION

LUBRICATION NOTES

These notes, which correspond to numbers placed opposite the (right-hand column) lubrication items on lubrication chart, include explanation of lubrication symbols, special lubrication instruc-

tions, and references to detailed instructions in other sections of this manual. Use these notes in conjunction with the lubrication chart on preceding pages.

NOTE NO. 1-ENGINE OIL

(See Symbol E on Chart)

TYPES OF OIL

Crankcase oils in service, unless protected against oxidation, may form sludge and varnish and under some conditions corrosive acids.

To minimize the formation of these harmful decomposition products and to supply the type of oil best suited for the different operating conditions, the oil industry markets several types of crankcase oils. These types are defined by the General Committee, Division of Marketing of the American Petroleum Institute, as follows:

"REGULAR MOTOR OIL, this term shall be used to designate a straight mineral oil. Oils of this type are generally suitable for use in internal combustion engines under moderate operating conditions. (Not recommended for GM Diesel Engines)

PREMIUM MOTOR OIL, this term shall be used to designate an oil having proved oxidation stability and bearing corrosion preventive properties. Oils of this type are generally suitable for use in internal combustion engines where operating conditions are such that regular oils do not give satisfactory service. (Not recommended for GM Diesel Engines).

HEAVY DUTY MOTOR OIL, this term shall designate an oil having oxidation stability, bearing corrosion preventive properties, and detergent-dispersant characteristics. Oils of this type are generally suitable for use in both High Speed Diesel and Gasoline Engines under heavy duty service conditions." (Recommended for GM Diesel Engines).

RECOMMENDED TYPE OF OIL

In heavy duty commercial service the crankcase oil usually operates at a much higher temperature than in light duty service and consequently is more subject to deterioration. Varnish on the pistons, valve stems, and tappets causes sluggish operation of the engine. Sludge will eventually clog the oil pump screen, oil passages and oil control rings.

The Regular or Straight mineral motor oils, are generally used under normal driving conditions

in some light commercial vehicles under very light service conditions and passenger car engines. However, this type of oil is not recommended for Diesel engines used in vehicles covered by this manual.

The Premium motor oils can be used in gasoline engines in commercial service where operating conditions are normal or average.

The Heavy Duty motor oils are recommended for use in all heavy duty commercial service gasoline engines and must be used in Diesel engines covered by this manual. Successful operation of Diesel engine requires the careful selection of a Heavy Duty detergent-dispersant type lubricating oil, which has proved oxidation stability and bearing corrosion preventive properties. Heavy Duty oils pick up and suspend fine particles of undesirable matter, thereby preventing their formation on engine internal surfaces. These contaminants are then drained with the oil at oil change periods.

SAE VISCOSITY NUMBERS

The SAE viscosity numbers constitute a classification of lubricants in terms of viscosity or fluidity, but with no reference to any other characteristics or properties.

The SAE viscosity numbers have been adopted by practically all oil companies, and no difficulty should be experienced in obtaining the proper viscosity grade in the different types of engine oils to meet seasonal requirements.

VISCOSITY RECOMMENDATION

Use SAE 30 engine oil for all normal operating conditions except when temperatures consistently below +30°F. are encountered. Where prolonged engine exposure to temperatures below freezing is unavoidable, use of 20W between +30°F. and 0°F. or 10W below 0°F. is suggested to facilitate cold starting.

OIL LEVEL

Check oil level daily; keep to "full" mark on dip stick. When oil filter element is renewed, oil strainer cleaned, or oil changed, engine should be run after filling and oil level rechecked.

LUBRICATION**DRAINING CRANKCASE**

The frequency with which crankcase oil must be changed depends upon the type and quality of oil used, the type or severity of operation, and the condition of the engine. It is therefore impossible to make a general recommendation concerning mileage intervals between oil changes. The oil should be changed often enough to keep it nonabrasive and noncorrosive. Oil changing is closely related to filter element and air cleaner element cleaning and changing, the frequency of which also depends upon the condition of operation mentioned above.

Laboratory test of oil drained from the engine, conducted by the oil supplier or by another suitable laboratory should be helpful in determining the greatest advisable interval between oil and filter element changes for your operation. Whether such tests are conducted or not, your oil supplier should be able to recommend suitable oil change periods for his oil in your operation.

CHANGING TYPE OF OIL

In some instances operators may be using "Regular" or "Premium" engine oils instead of the recommended "Heavy Duty" oil, or may desire to change brands. If this is the case the following procedure is recommended when "Heavy Duty" type engine oil is first used. The engine should not be run for more than 24 hours on the new oil, then drained and refilled. This prevents any dangerous obstruction of oil pump intake screen or oil strainer by any previously formed oxidation deposits which might be loosened by purging action of oil. The second crankcase filling should be drained out after running 40 hours, at which time oil filter element should be renewed. Following these two oil changes, the previously recommended or newly established oil drain periods can be followed.

OIL FILTER

Whenever engine oil is drained the oil filter element should be changed and filter cleaned. Filter element changing and cleaning filter should remove all accumulations of sludge and harmful abrasives that would otherwise contaminate the clean oil.

OIL STRAINER

Whenever engine oil is drained the oil strainer element and strainer should be cleaned. Wash inner and outer surfaces of element and strainer in suitable cleaning solvent. A fine bristle (not wire) brush is satisfactory for cleaning.

DOOR HINGES

At intervals recommended on lubrication chart, door hinges and operating mechanism should be lubricated to permit oil reaching friction points.

FRONT AND UNDER FLOOR HEATER MOTORS

At intervals recommended on lubrication chart apply light engine oil at heater motor oil cups. Refer to BODY (SEC. 3 of this manual) for location and accessibility of motors.

GENERATOR AIR CLEANER (Oil Wetted Type)

At interval recommended on lubrication chart, or more often if conditions warrant, remove and clean in cleaning solvent. Dry thoroughly. Use light grade oil to wet mesh element, then allow excess oil to drain off before installing.

AIR CLEANER (BLOWER)

Keep oil level in air cleaners to "Oil Level" mark. At intervals recommended on lubrication chart, or more often if conditions warrant, clean and refill. Use the same grade and type of oil as used in crankcase.

LINKAGE

At all linkage joints and clevis pins apply oil with brush, spray, or hand oil can.

STARTING MOTOR

At intervals recommended on Lubrication Chart apply SAE 20 engine oil at three oilers.

BRAKE SHOE ROLLER PINS

At intervals indicated on lubrication chart, apply engine oil sparingly to brake shoe roller pins on both sides of rollers. Pry shoe away from cam to permit spinning roller to work oil into inside of roller.

SHUTTER LINKAGE

As recommended on lubrication chart, radiator shutter linkage should be lubricated only when linkage is new.

LUBRICATION

NOTE NO. 2
LUBRICATING OIL—SPECIAL
(See Symbol ES on Chart)

The type of oil indicated by symbol "ES" must be carefully selected, as ordinary engine and gear oils are not satisfactory. Oil must be of good quality SAE 50 such as aviation grade engine oil, or SAE 50 Heavy Duty engine oil having detergent-dispersant properties, oxidation resistance, and anti-foam characteristics.

TRANSMISSION

At 1000 mile intervals, lubricant level should be checked. If necessary, add sufficient lubricant to bring level up to "Full" mark on dip stick. Drain and refill at least every 15,000 miles. Drain only while transmission is warm.

NOTE: Do not use extreme pressure or hypoid lubricants in transmission.

NOTE NO. 3
GEAR OIL
(See Symbol G on Chart)

Use gear oil of best quality. Oils undergo chemical changes at high temperature with thickening as the result. This instability, which should not be confused with viscosity (body), may produce oil that is too thick for adequate lubrication. Gear oils most resistant to thickening are filtered steam refined cylinder stock or bright stocks.

REAR AXLE

Keep lubricant to level of filler plug. Drain and refill at least every 15,000 miles. Drain while lubricant is warm, preferably immediately after operation. Use SAE 140 gear oil for summer, and SAE 90 for winter.

STEERING GEAR HOUSING

Use pressure gun at fitting and apply lubricant until it is up to level of vent plug. Use SAE 140 for summer and winter operation.

PROPELLER SHAFT UNIVERSAL JOINT

Use pressure gun at fitting and apply until lubricant is visible at relief valve. Use SAE 140 gear oil for summer, and SAE 90 during winter.

NOTE NO. 4
CHASSIS LUBRICANT
(See Symbol C on Chart)

Chassis lubricant should be used at all points indicated by symbol "C" on lubrication chart.

All pressure gun lubrication points must be clean before applying gun. Replace all broken or missing fittings. Apply sufficient lubricant to thoroughly lubricate entire bushing or bearing.

Chassis lubricant should be a high grade calcium or aluminum soap pressure gun lubricant. Sodium soap grease may be used as chassis lubricant, but more frequent application may be required during wet weather.

NOTE NO. 5
15% SODIUM SOAP GREASE
(See Symbol S2 on Chart)

A short fiber non-fluid sodium soap (approximately 15%) grease having a high melting point.

CLUTCH RELEASE BEARING

Keep cup full; turn down at intervals indicated on lubrication chart.

GENERATOR

Keep cups full; turn down at intervals specified.

CLUTCH PILOT BEARING

Rotate flywheel until plug appears at opening in bottom of flywheel housing. Remove plug and install temporary fitting. Use hand gun to apply lubricant sparingly. Do not use excessive lubricant. Remove fitting and replace plug.

BRAKE SHOE ANCHOR PINS

Remove plugs, install temporary fittings. Use pressure gun, apply lubricant sparingly. Remove temporary fittings and replace plugs.

WHEEL BEARINGS

Remove wheel bearings as instructed in HUBS AND BEARINGS (SEC. 19 of this manual). Wash bearings, hub, and spindle in cleaning solvent. Inspect hub and bearings. Coat spindle and inside of hub with thin coat (approximately 1/8" thick) of grease to prevent rusting. Lubricate bearings thoroughly, using a lubricator or by hand pack method. Be sure lubricant reaches into all spaces of the bearing. DO NOT FILL HUB. Reinstall and adjust bearings as directed in HUBS AND BEARING (SEC. 19 of this manual.)

STEERING GEAR UPPER BEARING

Pack upper bearing at assembly of steering gear. Refer to SEC. 16 of this manual.

NOTE NO. 6
PETROLEUM JELLY
(See Symbol S3 on Chart)

BATTERY TERMINALS

Keep battery terminals clean. At regular periods, remove cables, clean terminals on cables and battery. Apply petroleum jelly after tightening terminals to prevent corrosion.

LUBRICATION**BRAKE APPLICATION VALVE**

At time of reassembly apply petrolatum at points indicated in BRAKES (SEC. 4 of this manual). Follow instructions carefully when applying lubricant.

**NOTE NO. 7
GRAPHITE GREASE**
(Symbol S5)

A high temperature grease containing graphite or other inert materials.

CLUTCH SHAFT SPLINES

At time of assembly apply lubricant to clutch shaft splines and hub. Do not use an excessive amount of lubricant as it may reach the clutch facings.

**NOTE NO. 8
SHOCK ABSORBER FLUID**
(See Symbol S6 on Chart)

A special shock absorber fluid (Delco) should be used whenever additional fluid is necessary.

SHOCK ABSORBERS

At specified intervals, level of fluid in shock absorbers should be checked. Disconnect link at shock absorber arm as directed in SPRINGS (SEC. 15 of this manual). Remove plug from shock absorber body. Move shock absorber arm up and down slowly as fluid is added. Continue arm movement and adding operations until fluid level remains at plug opening level. Replace plug and reconnect link.

**NOTE NO. 9
DENATURED ALCOHOL**
(See Symbol S10 on Chart)

Use alcohol antifreeze solutions as directed in COOLING SYSTEM (SEC. 6 of this manual.)

SHUTTER THERMOSTAT

Disconnect line at thermostat and inject 1 ounce denatured alcohol at intervals indicated. Refer to "RADIATOR, SHUTTER, AND THERMOSTAT" in COOLING SYSTEM (SEC. 6).

**NOTE NO. 10
CASTOR OIL**

(See Symbol S11 on Chart)

Use of a good grade commercial castor oil is recommended at indicated intervals.

SHUTTER AIR CYLINDER

Remove screw plug and inject 1/2 ounce of recommended fluid at specified intervals. Replace plug.

**NOTE NO. 11
HYDRAULIC BRAKE FLUID**
(See Symbol S12 on Chart)

Fluid recommended for this application should be Delco Super #11 or Wagner Lockheed #21-11.

SWAY BAR BUSHINGS AND LINKS

At intervals recommended on lubrication chart, sway-bar rubber bushings and shock absorber links should be sprayed or brushed with recommended fluid which serves as a rubber preservative.

**NOTE NO. 12
AIR FILTER FLUID**
(See Symbol S13 on Chart)

Recommended fluid for this application is a special air filter fluid which is compounded especially for use in this filter.

SHUTTER AIR FILTER

Remove plug at top of filter reservoir. Inject 1 ounce of recommended fluid at specified intervals. Larger quantities of more frequent fillings are not recommended as system may be overloaded. Replace plug.

Weekly during summer months, or daily during winter, open the pet cock at bottom of filter to drain accumulated moisture. Drain under pressure.

**NOTE NO. 13
FLAKE GRAPHITE**
(Symbol S18)

Use a commercially available, finely divided powdered graphite.

CONTROL ROD LOOM

Whenever control rods and loom are removed or replaced, inside of loom must be lubricated. Pour or blow a quantity of lubricant inside loom, then plug ends of loom. Tip loom up and down until inside is thoroughly covered.

SERVICE BULLETINS

NOTES

This image shows a single sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

Spring Suspension

Vehicle chassis and body are supported by semi-elliptic type springs. Front springs are mounted on top of front axle (fig. 1), and rear springs are suspended under rear axle housing (fig. 2). Front and rear spring assemblies are attached to axles with U-bolts. Forward ends of springs are secured in stationary brackets and rear ends are shackled to permit longitudinal movement. Bracket pins and shackle bolts are threaded full length, as are the spring eye bushings.

Spring leaves are held in alignment by four rebound clips. Each clip consists of a U-shaped strap with a bolt passing through upper ends and over top spring leaf. Bottom of clip is riveted to shortest spring leaf which it retains.

GENERAL SPRING MAINTENANCE

LUBRICATION

Spring leaves are lubricated at time of assembly, and may be periodically lubricated as required.

Bracket pins and shackle bolts are drilled and equipped with lubrication fittings. Pins and bolts should be lubricated at intervals indicated in LUBRICATION (SEC. 13).

Do not lubricate shock absorber linkage or sway bar linkage with oil. Links are rubber bushed, and oil will cause deterioration of the rubber. Spray linkage with hydraulic brake fluid as directed in LUBRICATION (SEC. 13).

TIGHTENING

At regular intervals, spring U-bolts should be tightened to torque listed in "Specifications" at end of this section. Tightening should be accomplished with vehicle under normal load. When tightening U-bolts at rear springs, place jack under spring lower retainer and raise enough to remove weight from U-bolts.

IMPORTANT: U-bolts must be kept **TIGHT** at all times.

The center bolt serves only to hold the spring leaves together while in shipment and during installation, and as a locating point when assembling spring to axle. After assembly it is strictly the responsibility of the U-bolts to hold the axle in alignment. The importance of keeping the U-bolts tight cannot be overemphasized.

Make sure rebound clip bolts are tightened sufficiently to hold spring leaves in alignment without restricting free movement of leaves. Spring

shackle and bracket bolts, and front spring anchor bracket bolts must be kept tight.

FRONT SPRINGS

(Refer to Figure 1)

REMOVAL

1. Block rear wheels to prevent vehicle rolling. Jack up front end of coach until tension is removed from springs. Place block under end of axle from which spring is to be removed.

2. Disconnect shock absorber link from spring retainer at bottom of axle. Loosen spring U-bolt nuts.

3. Remove lubrication fittings from front spring rear shackle bolts, then remove nuts and lock washers from both ends of shackle bolts. Remove shackle plates.

4. Remove lubrication fitting from end of spring bracket pin. Remove nuts and lock washers from spring front anchor block bolts and drive out bolts. Remove anchor block from each end of spring bracket pin.

5. Remove U-bolt nuts and lower spring retainer. Remove U-bolts and upper retainer from top of spring. Lift spring assembly from top of axle housing. Remove spring seat from axle.

DISASSEMBLY

1. Unscrew shackle bolt and bracket pin from spring eye bushings.

2. Remove rebound clip bolts and spacers.

3. Clamp spring leaves firmly together, using one C-clamp on each side of center bolt, or using an arbor press. Remove center bolt, then release C-clamps or arbor press slowly to avoid possible injury.

CLEANING AND INSPECTION

1. Clean all rust and dirt from spring leaves, using a wire brush if necessary. Wash all grease from inside of spring eye bushings and from shackle and bracket pins and bolts. Make sure lubricant passages are open.

2. Inspect spring leaves for cracks or breaks and replace any that are damaged.

3. Check fit of shackle and bracket pins and bolts in spring eye bushings. Replace pins, bolts, or bushings as necessary, if excessive clearance is evident.

4. Remove shackle bolt from rear shackle frame bracket, wash bolt and bushing in bracket, then check fit of bolt in bushing. If excessively loose, replace bolt or bushing.

SPRING SUSPENSION

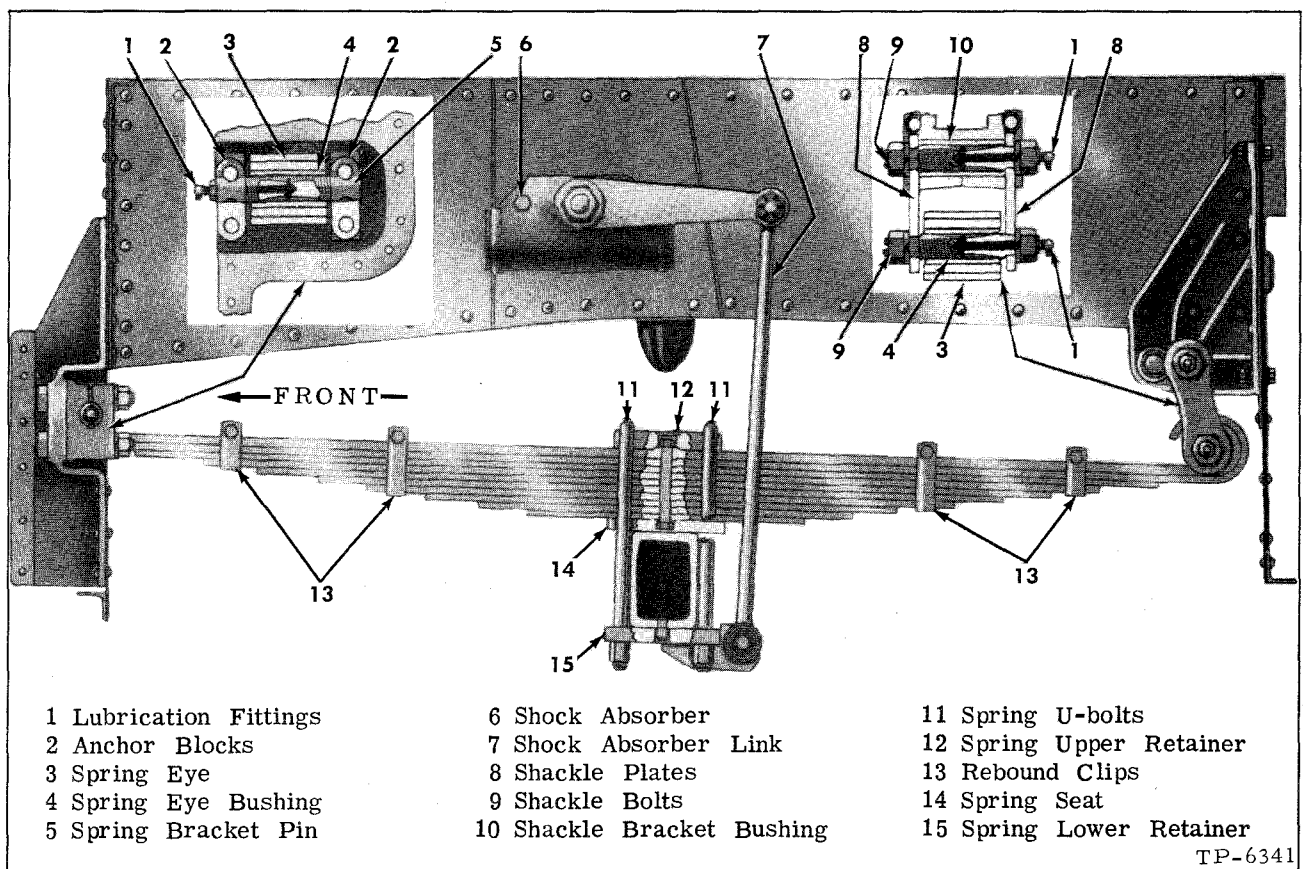


Figure 1—Front Spring and Shock Absorber Installation

5. To replace spring eye bushings and frame bracket bushing, press old bushings out and press new bushings into place.

6. Replace any rebound clips which are broken or damaged.

ASSEMBLY

1. Coat spring leaves with a light film of graphite grease. Stack spring leaves in correct order, then compress spring leaves using C-clamps or arbor press. Install center bolt, with nut at bottom, and tighten firmly.

2. Install rebound clip spacers and bolts. Tighten sufficiently to hold spring leaves in alignment without restricting free movement of leaves.

3. Thread shackle bolt into frame bracket bushing, and thread shackle and bracket bolt and pin into spring eye bushings. Bolt threads and pin must extend out of bushings an equal distance at both ends.

INSTALLATION

1. Place spring seat on axle housing with dowel in seat engaging hole in housing. Position spring assembly on seat with center bolt nut in hole in seat. The double wrapped spring eye must be toward front of vehicle.

2. Position upper retainer on top of spring, then place U-bolts over retainer and spring. Install spring lower retainer over lower ends of U-bolts and install nuts. Do not tighten.

3. Place spring front anchor block on each end of spring pin. Turn pin as necessary to align grooves with anchor block bolt holes, then install bolts attaching anchor blocks to frame bracket.

NOTE: Make sure spring end is centered between anchor blocks; if necessary, remove anchor block bolts and turn pin as necessary to center spring end. Tighten anchor block bolts firmly. Install lubrication fitting in spring pin.

4. At rear end of spring, install shackle plates over both ends of shackle bolts. Install lock washers and nuts on ends of bolts. Make sure spring end is centered between shackle plates. If necessary, turn shackle bolt as required to center spring end. Tighten nuts firmly, then install lubrication fittings in outer ends of bolts.

5. Tighten spring U-bolt nuts firmly, then connect shock absorber link to spring lower retainer. Remove blocks and jacks from under vehicle, place vehicle under normal load, then tight-

SPRING SUSPENSION

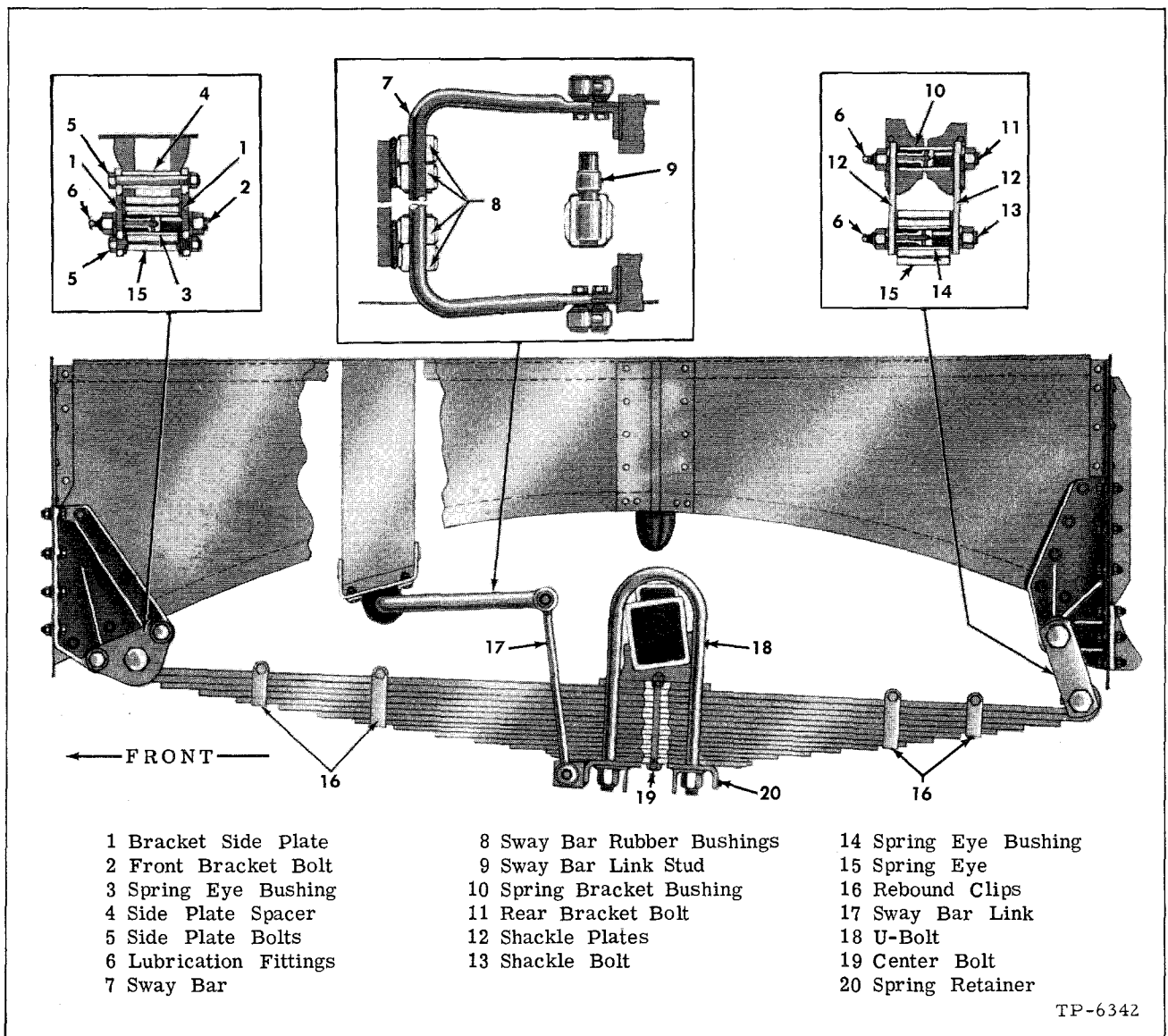


Figure 2—Rear Spring and Sway Bar Installation

en U-bolt nuts to torque listed in "Specifications" at end of this section.

6. Lubricate spring bracket and shackle pins and bolts as directed in LUBRICATION (SEC. 13).

REAR SPRINGS

(Refer to Figure 2)

REMOVAL

1. Block front wheels to prevent vehicle rolling. Jack up rear end of coach until tension is removed from springs. Place block under end of axle from which spring is to be removed.

2. Disconnect sway bar link (and shock absorber link, if used) from spring lower retainer. Loosen spring U-bolt nuts.

3. Remove lubrication fitting from end of spring front bracket bolt. Remove nut and lock washer from each end of bolt. Remove nuts, lock washers, bolts, and spacers attaching front bracket side plates to frame bracket. Remove side plates from bracket bolt.

4. Remove lubrication fittings from spring rear shackle bolts. Remove nuts and lock washers from both ends of shackle bolts, then remove shackle plates.

5. Support spring, then remove U-bolt nuts and spring lower retainer. Remove support from under spring and remove spring assembly.

DISASSEMBLY

1. Unscrew shackle and bracket bolts from spring eye bushings.

SPRING SUSPENSION

2. Remove rebound clip bolts and spacers.
3. Clamp spring leaves firmly together, using one C-clamp on each side of center bolt, or using an arbor press. Remove center bolt, then release C-clamps or arbor press slowly to avoid possible injury.

CLEANING AND INSPECTION

1. Clean all rust and dirt from spring leaves, using a wire brush if necessary. Wash all grease from inside of spring eye bushings and from shackle and bracket bolts. Make sure lubricant passages are open.
2. Inspect spring leaves for cracks or breaks and replace any that are damaged.
3. Check fit of shackle and bracket bolts in spring eye bushings. Replace bolts or bushings as necessary, if excessive clearance is evident.
4. Remove shackle bolt from rear shackle frame bracket, wash bolt and bushing in bracket, then check fit of bolt in bushing. If excessively loose, replace bolt or bushing.
5. To replace spring eye bushings and frame bracket bushing, press old bushing out and press new bushing into place.
6. Replace any rebound clips which are broken or damaged.

ASSEMBLY

1. Coat spring leaves with a light film of graphite grease. Stack spring leaves in correct order, then compress spring leaves using C-clamps or arbor press. Install center bolt, with nut at bottom, and tighten firmly.
2. Install rebound clip spacers and bolts. Tighten sufficiently to hold spring leaves in alignment without restricting free movement of leaves.
3. Thread shackle and bracket bolts into spring eye bushings. Bolt threads must extend out of bushings an equal distance at both ends.

INSTALLATION

1. Position spring assembly under axle housing with double wrapped spring eye toward front of vehicle, and center bolt head engaging hole in center of spring seat. Block spring in place.
2. Install U-bolts, lower retainer, and nuts. Do not tighten.
3. At front end of spring, place bracket side plate on each end of bolt and install lock washer and nut on each end. Install side plate spacers and bolts and tighten firmly. Turn spring bracket bolt as necessary to center spring end between side plates, then tighten nut on each end of bolt. Install lubrication fitting in outer end of bolt.
4. At rear end, install shackle plate on each end of shackle and bracket bolts, and install lock washers and nuts. Turn shackle bolt as necessary to center spring end between shackle plates, then

tighten all shackle bolt nuts firmly. Install lubrication fitting in outer end of both bolts.

5. Loosen five nuts attaching camshaft bearing to spring seat bracket until lock washers are free, then firmly tighten U-bolt nuts. Apply and release brakes to permit camshaft and bearing to align, then securely tighten camshaft bearing to spring seat nuts.

6. Connect sway bar links (and shock absorber links, if used) to spring lower retainer.

7. Remove jacks and blocks from under vehicle and place vehicle under normal load. Place jack under spring lower retainer and raise enough to remove weight from U-bolts, then tighten U-bolt nuts to torque listed in "Specifications" at end of this section.

8. Lubricate spring bracket and shackle bolts as directed in LUBRICATION (SEC. 13).

SHOCK ABSORBERS

Front shock absorbers are standard equipment; rear shock absorbers are only available as special equipment. Shock absorbers are double-acting hydraulic type, interconnecting frame and axle through links (fig. 1).

Shock absorber sectional view, showing direction of fluid flow during compression and rebound, is shown in figure 3.

MAINTENANCE

Units should be inspected, links tightened, and fluid level checked at regular intervals. Valves of proper spring strength and orifice size have been selected to give the best possible performance and should not be changed under ordinary conditions.

While units are constructed so as to permit overhauling in the field, this operation requires special tools and equipment. If facilities are not available to do this work, shock absorbers may be taken to any GMC Service Station for repair or complete overhaul. Shock absorbers should be overhauled approximately every 50,000 miles.

FLUID

When refilling units with fluid, use only fluid recommended in LUBRICATION (SEC. 13). This fluid is non-corrosive and has only a slight change in viscosity over a wide range of temperatures.

TESTING

Disconnect link from spring retainer and pull shock absorber arm down. If arm drops easily part way, then stops and continues moving down slowly, there is not enough fluid in unit.

FILLING

Clean exterior of unit. Remove filler plug; then fill with correct fluid to bottom of filler plug

SPRING SUSPENSION

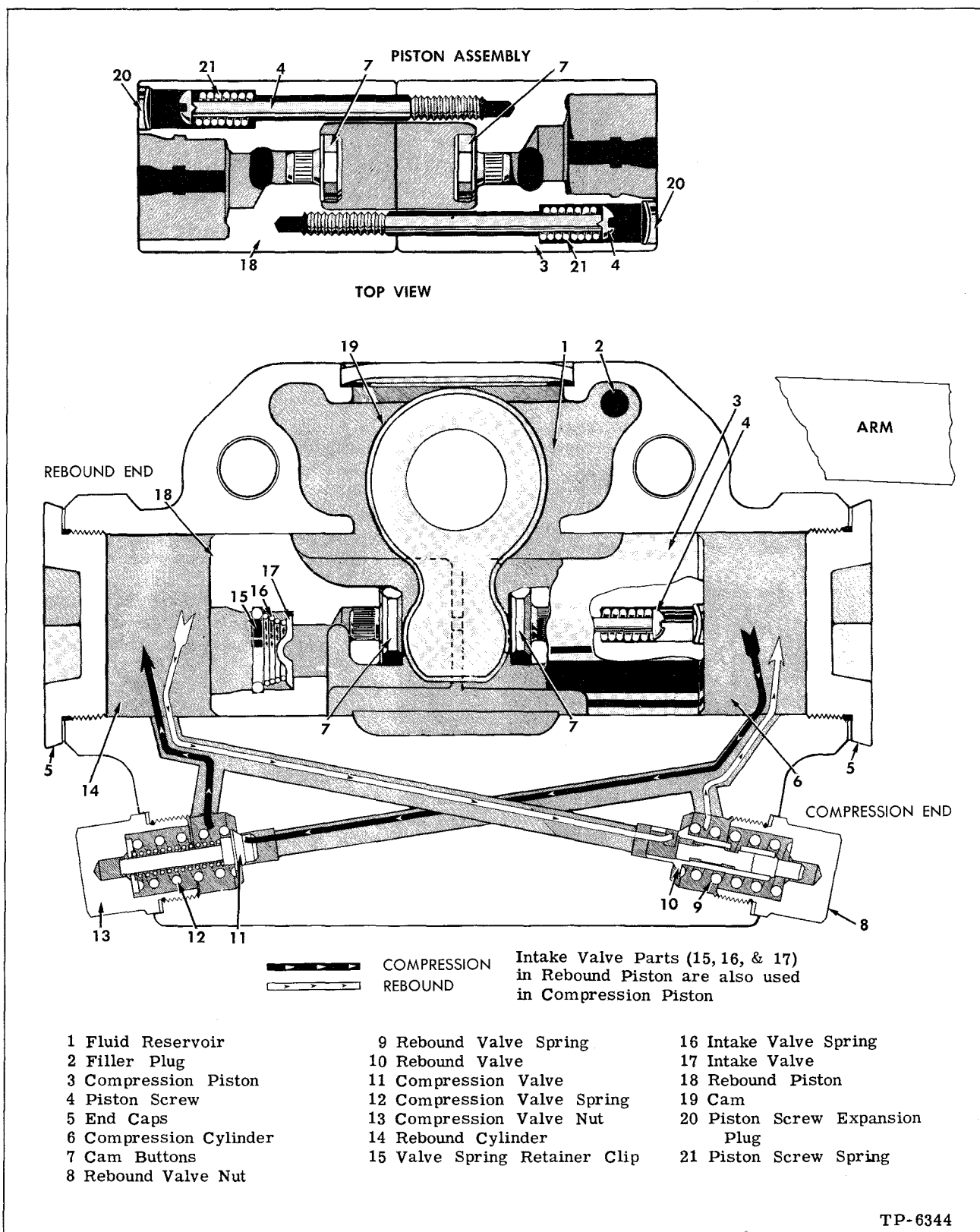


Figure 3—Shock Absorber Construction and Operation

SPRING SUSPENSION

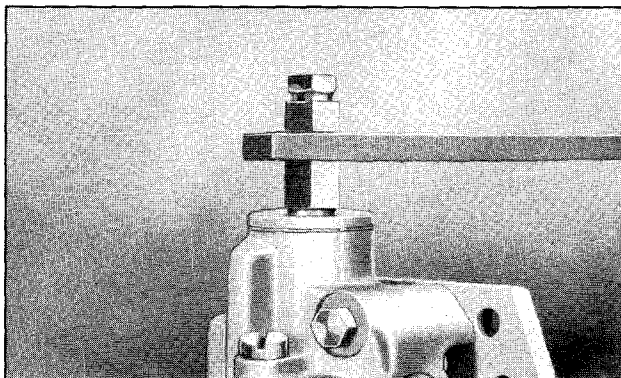


Figure 4—Removing Shock Absorber End Cap

hole. Replace filler plug and move shock absorber arm up and down to work fluid into piston cylinders; then add enough fluid to fill reservoir. To provide necessary air space, allow fluid to escape down to lower edge of filler plug hole before replacing plug. If leaks are evident around end caps, valve plugs, or filler plug, replace gaskets.

Packing washers on shock absorbers which have been operating with fluid below proper level may become worn, causing leaks around shaft. This necessitates replacement of shock absorber.

REPLACEMENT

While shock absorber can be removed with wheel in place, removal of wheel will make shock absorber more accessible. Disconnect link from shock absorber arm. Disconnect unit from frame side rail, and remove from vehicle.

To install shock absorber, reverse removal procedures. Tighten link stud nuts to torque listed in "Specifications" at end of this section.

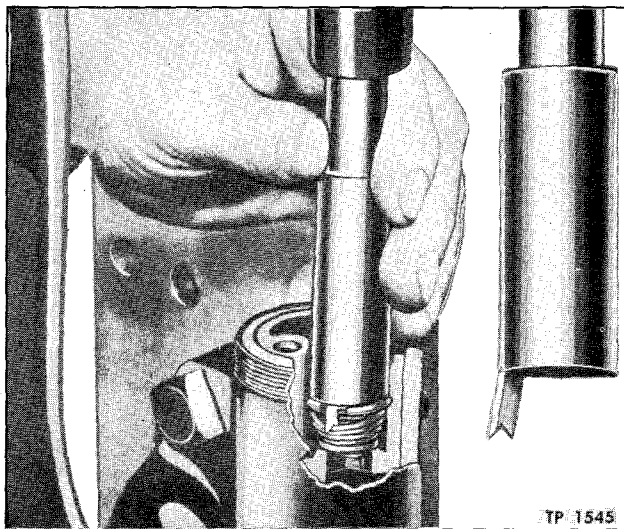


Figure 5—Installing Valve Spring Retainer

SHOCK ABSORBER OVERHAUL

If shock absorber body or arm is broken, arm is "frozen," absorber leaks at arm, or there is no resistance in unit when arm is moved and unit is full of fluid, shock absorber should be overhauled.

DISASSEMBLY (Fig. 3)

1. Remove dirt, grease, and loose paint from exterior.

2. Remove unit from vehicle and place in vise, being careful to clamp vise so as not to cause a bind on pistons.

3. Remove filler plug, drain fluid completely; then remove end caps with special tool (J-767) as shown in figure 4.

4. Remove relief valve nuts (8 and 13), rebound valve (10), compression valve (11), and intake valves (17). To remove intake valves, first remove valve spring retainer clip (15) with a screw driver; then lift out springs (16) and valves.

5. Remove plugs (20) over piston screws (19); then disassemble pistons (13 and 18) by removing piston screws (4) and remove from cylinder.

6. Wash all parts in kerosene; then inspect for wear. Clean valve orifices with compressed air.

7. Check camshaft for wear in housing by moving shock absorber arm sideways. If shaft is galled or worn, replace complete shock absorber.

ASSEMBLY (Fig. 3)

1. Assemble pistons in cylinder, keeping the cam clearance in pistons up.

2. Tighten piston screws firmly, then back off one to one and a half turns to prevent binding between cam (19) and cam buttons (7); then install new plugs (20) over piston screws.

3. Replace intake valves (17), springs (16), and valve spring retainer clips (15), using special tool (J-896-A) as shown in figure 5.

4. Install rebound valve (10), spring (9), and valve nut (8). Install compression valve (11), spring (12), and valve nut (13). Use new gaskets.

5. Install one end cap (5) using new gasket; then rotate unit and fill to capacity with fluid. While filling, move arm to expel air from fluid.

6. Install other end cap; then fill unit as previously directed under "Filling" in this section.

NOTE: Shock absorber body, arm, packing gland, camshaft, and cam are not replaceable due to special fixtures and presses required to assemble and disassemble these parts.

SHOCK ABSORBER LINKS

Links are used between shock absorber arm and axle as shown in figure 1. Unsatisfactory

SPRING SUSPENSION

shock absorber action and noise may be caused by worn joints in links. To determine if and where worn condition exists, disconnect link and check for looseness in joints at both ends of link. If joints are worn, new links must be installed.

SWAY BARS

To minimize road shocks and swaying of rear end of vehicle, rubber mounted sway bars have been installed on rear of vehicle. Transverse section of sway bar is mounted in four rubber bushings and is attached to coach side rail support brackets with four U-shaped clips as shown in figure 2. Arms of sway bar are connected to spring retainer plate assembly with rubber bushed link arms.

Unsatisfactory sway bar action and noise may be caused by worn joints in link between spring retainer plate and sway bar arms. To determine if and where worn condition exists, disconnect link and check for looseness in joint at both ends of link. If joints are worn, install new links.

SUPPORT BUSHING REPLACEMENT

If it becomes necessary to replace rubber support bushings, proceed as follows:

1. Jack up rear of vehicle to relieve spring tension; then disconnect sway bar links from spring retainer plate assembly.
2. Disconnect sway bar links from sway bar arms.
3. Remove bolts attaching U-shaped clips and sway bar crossmember to frame side rail support brackets.
4. Slip worn bushings off over ends of sway bar crossmember.
5. Coat new rubber bushings with hydraulic brake fluid; then slide bushings into place over ends of sway bar crossmember.
6. Reinstall sway bar and linkage, reversing steps listed above for removal. Tighten sway bar link stud nuts to torque listed in "Specifications" at end of this section. Always use new cotter pins when reinstalling linkage and be sure eye of sway bar is properly seated on tapered stud in joint.

SPRING SPECIFICATIONS

FRONT SPRINGS

Spring Leaves	
No. of Leaves	11
Thickness	1 @ 0.447", 1 @ 0.401", 7 @ 0.323" --- Total 3.829"
Width	4"
Length	
Center to Center of Spring Eyes	58" $\pm$ 1/16"
Center of Front Eye to Center Bolt	30" $\pm$ 1/16"

REAR SPRINGS

Spring Leaves	
No. of Leaves	14
Thickness	3 @ 0.499", 5 @ 0.447", 5 @ 0.401", 1 @ 0.360", --- Total 6.097"
Width	4"
Length	
Center to Center of Spring Eyes	72" $\pm$ 1/16"
Center of Front Eye to Center Bolt	39-1/2" $\pm$ 1/16"

SPRING EYE BUSHINGS

Outside Diameter	
New	1.762" - 1.765"
Service	1.794" - 1.797"
Length	4"
Thread	1-3/8" - 6 U.S.F. Tap

SHOCK ABSORBERS

Make	Delco Products
Type	Double-Acting
Model No. and Valving	
Right Front	1697-V - 6E - B6
Left Front	1697-W - 6E - B6
Right Rear (Spec. Equip.)	1699-P - 6B - B6
Left Rear (Spec. Equip.)	1699-N - 6B - B6

TORQUE SPECIFICATIONS

Shock Absorber & Sway Bar Link Studs	85-95 ft.-lbs.
Spring U-bolt Nuts -	
Front	230-270 ft.-lbs.
Rear	510-600 ft.-lbs.

SERVICE BULLETINS

NOTES

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Steering Gear

The steering mechanism comprises the steering gear assembly, connecting linkage, and allied parts of the front axle. The steering gear assembly is connected to steering arm at left-hand steering knuckle through the Pitman arm and drag link. Front axle parts pertinent to steering are covered in FRONT AXLE (SEC. 1).

Steering gear (fig. 5) is cam and roller, twin lever type. The only contact between actuating and actuated members of gear is rolling-line-contact between lever studs and cam grooves. Clearance between studs and cam can be adjusted by means of adjusting screw and lock nut, accessible from under vehicle, as described under "Steering Gear Adjustments" later in this section.

OPERATION

Operation of steering gear is essentially the same as a conventional type gear, except that steering effort is transmitted to steering gear proper by means of a universal jointed shaft. Two tapered studs, mounted on tapered roller bearings in lever shaft, mesh with spiral grooves cut in lower end of steering shaft (cam). As steering wheel is turned, tapered studs follow grooves in cam, causing lever shaft to turn. Movement of lever shaft is transferred to front wheels through Pitman arm, drag link, axle steering arms, and tie rod.

MOUNTING

Steering gear and drag link installation views are shown in figure 1. Steering gear assembly is attached to vehicle understructure by bolts. Steering column passes through a sponge rubber seal at floor. Seal is held in place by steering column closure and dimmer switch adapter plates. Since upper end of steering column is not anchored, steering shaft will always be in free position; thus eliminating possibility of misalignment in column.

INSPECTION AND LUBRICATION

The following light maintenance operations include items which should be periodically inspected. Minor repairs and adjustments, which may be accomplished without removing steering gear from vehicle, are included.

1. At regular intervals check and tighten, if necessary, all steering gear mounting bolts, Pitman arm retaining nut, and housing side cover attaching bolts.

2. Inspect drag link and steering gear adjustments and adjust, if necessary. Refer to "Steering Gear Adjustments," later in this section, for method of checking steering gear adjustment and refer to "Steering Drag Link" for drag link information.

3. Lubricate steering gear and allied units as directed in LUBRICATION (SEC. 13).

STEERING GEAR ADJUSTMENTS

Before an attempt is made to remedy steering difficulties by adjusting steering gear, other factors which might cause hard or otherwise unsatisfactory steering should be checked. Reference should be made to TROUBLE SHOOTING (SEC. 21), for steering gear trouble diagnosis and remedial measures. It is important that steering gear be properly adjusted to assure satisfactory steering and prevent excessive wear of parts. Adjustments for ball thrust bearings on cam and for minimum backlash of tapered lever shaft studs in cam groove are provided. Always check cam bearing and, if necessary, adjust before making lever shaft backlash adjustment. Prior to performing adjustments, following preliminary operations are necessary:

1. Disconnect steering drag link from Pitman arm to free gear from load. Note relative positions of parts. Link must remain disconnected until all adjustments are completed.

2. Tighten bolts which mount steering gear housing to understructure.

CAM BEARING ADJUSTMENT

Before making adjustment, loosen lever shaft thrust adjusting screw (14, fig. 5) to free studs in cam groove; then proceed as follows:

1. Loosen four upper housing cover to housing stud nuts; then move housing cover until shims are accessible.

2. Shims are of .002, .003, and .010 inch thickness. Clip and remove one of the thinner shims; then tighten four cover nuts securely.

3. Test adjustment. Cam bearing adjustment is correct when a barely perceptible drag is felt when steering wheel is turned while gripped tightly at rim with thumb and forefinger. If steering wheel will not turn freely, adjustment is too tight.

4. If further adjustment is required, remove or add shims until correct adjustment is obtained.

STEERING GEAR

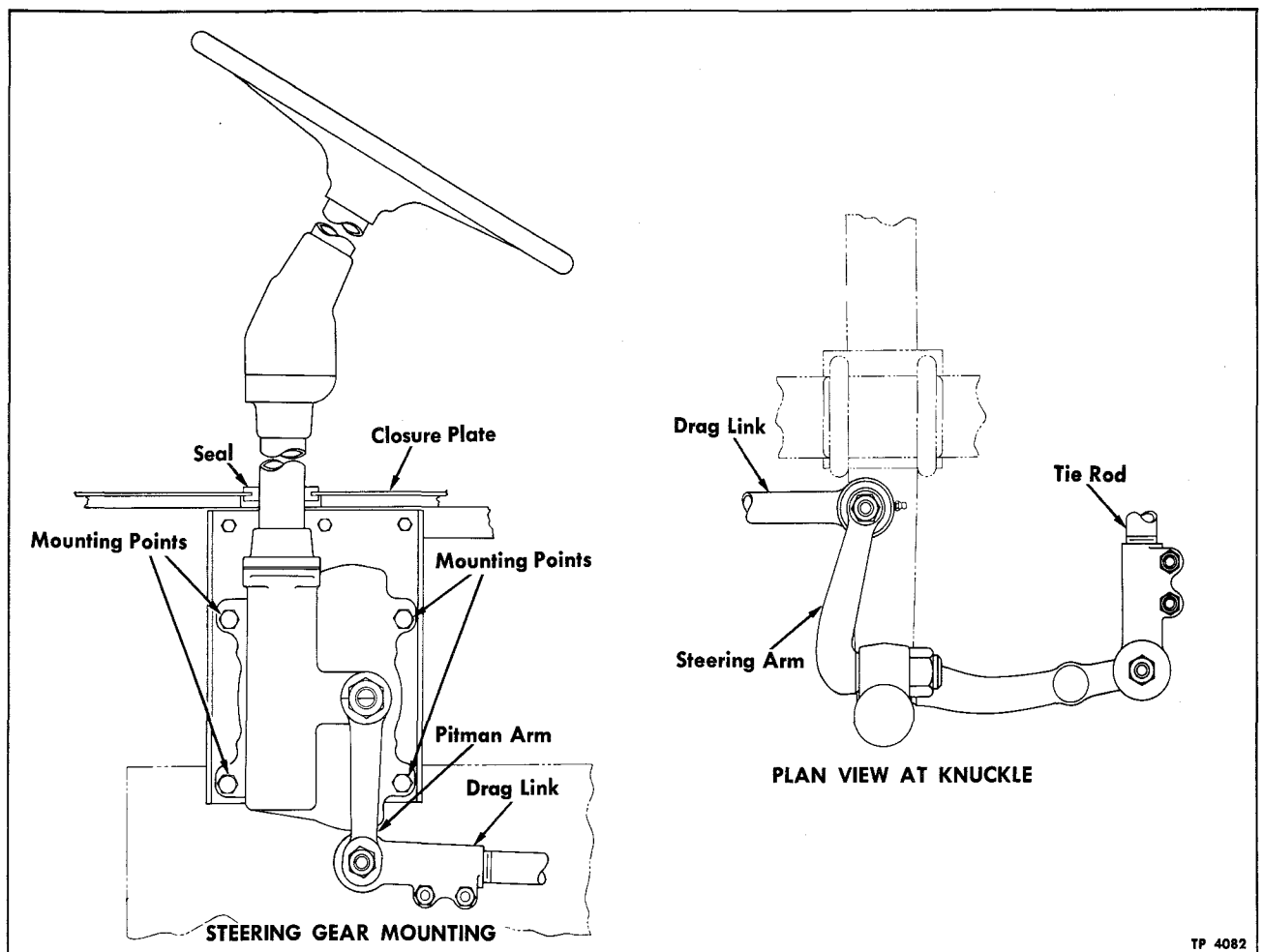


Figure 1—Steering Gear Installation Views

NOTE: If it is necessary to install new shims to obtain correct cam bearing adjustment, shims may be cut in half and inserted between other shims temporarily. Be careful, however, that ends of shim do not overlap and that half-shims do not drop out while tightening cover nuts. Shims installed in this manner must always be replaced by whole shims at earliest opportunity.

LEVER SHAFT THRUST ADJUSTMENT

Since larger portion of driving is done when traveling in an approximately straight line, more wear occurs in steering gear within about one-quarter wheel turn either side of straight-ahead position. For this reason, within this range, width of cam groove is narrower than elsewhere, making it possible to adjust gear for wear without binding in extreme positions. It is important to note that lever shaft thrust be adjusted with lever shaft in position where width of cam groove is

narrowest; that is, within one-half wheel turn of straight-ahead driving range.

Lever shaft thrust adjustment is made by means of adjusting screw (14, fig. 5) located in side cover at inner end of lever shaft. Be sure cam bearings are adjusted properly; then proceed as follows:

1. Disconnect steering drag link at Pitman arm.
2. Center steering gear by turning steering wheel from right or left extreme, carefully counting number of turns; then rotate wheel back exactly half way. Mark wheel at top or bottom center with a piece of tape.
3. Loosen lock nut on adjusting screw; then tighten adjusting screw until all lever shaft thrust is removed.
4. Back off adjusting screw until only a very slight drag is felt through the mid-position, when turning steering wheel slowly from one extreme position to the other.

STEERING GEAR

5. Tighten lock nut securely and again test adjustment to make sure that lever shaft thrust did not change when lock nut was tightened. Connect steering drag link to Pitman arm.

When steering gear is properly adjusted, lever shaft will have a slight amount of thrust. This thrust is necessary to insure proper lubrication, because film of lubricant must separate lever studs and walls of cam groove at all times or rapid parts wear will result. A closer adjustment will not correct any steering condition, but will serve only to damage and wear parts and impair operation.

ADJUSTING STUD ROLLER BEARING UNITS

The foregoing adjustments will suffice in most cases; however, it may be necessary to adjust stud roller bearing units in lever shaft. This adjustment necessitates removing steering gear from vehicle as directed under "Steering Gear Removal" and performing steps 1 through 4 under "Steering Gear Disassembly," later in this section.

The roller bearings should be preloaded at all times. Adjust to a heavy drag. Used units should be set lighter than new replacement units but never below a minimum stud turning torque of 4 to 8 inch-pounds. Factory adjustments on new units are within these limits.

Stud roller bearing adjustment may be accomplished as directed below. Refer to figure 2.

1. Thoroughly clean all parts of stud roller bearing units and lever shaft in a suitable cleaning solvent.

2. Press outer bearing races into lever shaft with flanged end of races toward Pitman arm end of shaft. Coat inside surface of outer races with soft cup grease or vaseline to hold rollers in position during assembly. Install rollers, studs, inner races, lock washers, and lock nuts in bearing outer races.

3. Place assembly in vise with stud nuts up, and with vise jaws gripping the straight portion of the studs. Extreme care must be used to prevent damage to stud bearing surfaces.

4. Tighten stud nuts firmly, tapping both sides of lever with soft metal hammer to seat bearings properly. Back off stud nuts slightly.

5. Remove from vise and remount in vise with jaws gripping lever. Use torque wrench on nuts to rotate studs to test adjustment.

6. When adjustment is within correct limits, lock adjustment by bending prong of lock washers up against side of nuts. Bend the prong that is at right angle to a side of the nut. **DO NOT USE A LOCK WASHER TWICE UNLESS PRONGS USED BEFORE HAVE BEEN REMOVED.**

7. Lubricate stud roller bearing units with lubricant specified in LUBRICATION (SEC. 13).

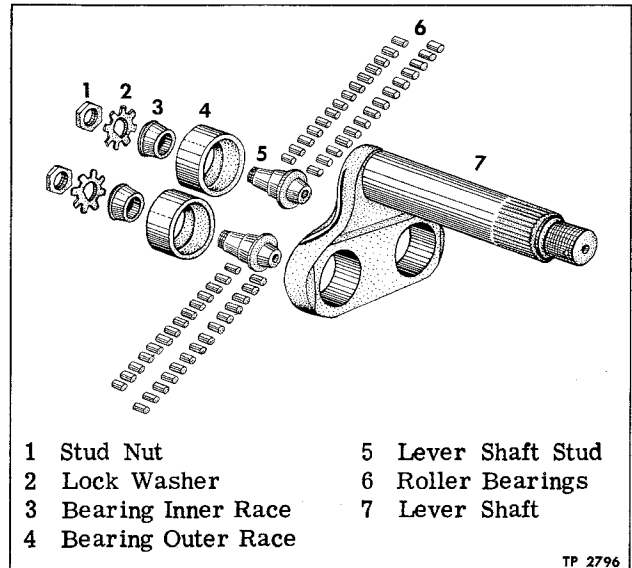


Figure 2—Lever Shaft Assembly Components

STEERING GEAR OVERHAUL

Whenever, due to excessive wear, steering gear assembly cannot be adjusted properly, or if during adjustment, "lumpy" or rough action is noticed, it will be necessary to overhaul steering gear assembly. Steering gear should be removed from vehicle for all overhaul or repair operations.

STEERING GEAR REMOVAL

Perform following steps in order given to remove steering gear assembly from vehicle. Refer to figures 1 and 6.

1. Remove three screws which attach horn button cap retainer to steering wheel. Remove retainer, insulator, horn button, contact plate, and bronze spring. Pull horn connector assembly carefully from steering wheel.

2. Remove steering wheel retaining nut; then using steering wheel puller similar to one illustrated in figure 3, pull wheel off upper steering shaft. Remove key from keyway in upper shaft; then remove switch operating plate and bearing spring.

3. Loosen switch clamp screw; then pull horn contact and directional signal switch from upper jacket tube.

NOTE: Horn and signal cables are long enough to permit removal of parts without disconnecting wires.

4. Remove steering column closure and dimmer switch adapter plates, with rubber seal, from around steering column at vehicle floor.

5. Disconnect drag link from Pitman arm by removing cotter pin and nut from drag link end stud and driving stud out of Pitman arm.

STEERING GEAR

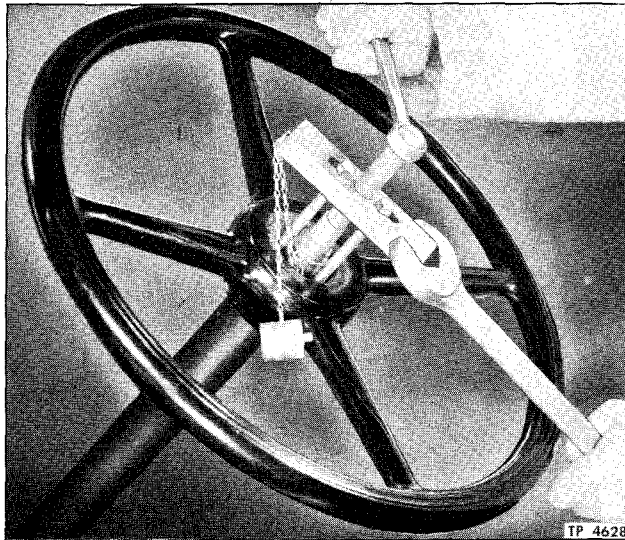


Figure 3—Steering Wheel Removal

6. Remove four bolts which attach steering gear housing to understructure, then remove steering gear assembly from underneath coach.

7. Remove Pitman arm retaining nut and lock washer. Note aligning marks on Pitman arm and lever shaft. If marks are not clearly discernible, punch mark both parts; then remove Pitman arm, using a suitable puller.

NOTE: Pitman arm may be removed from lever shaft while steering gear is installed in vehicle, if so desired.

STEERING GEAR DISASSEMBLY

Prior to disassembly operations, make sure that steering gear, work bench, and tools are clean. Steering gear parts must be kept clean. When mounting steering gear in vise or other holding fixture, do not grip housing too tightly or housing may be damaged. Refer to figures 5 and 6 for information.

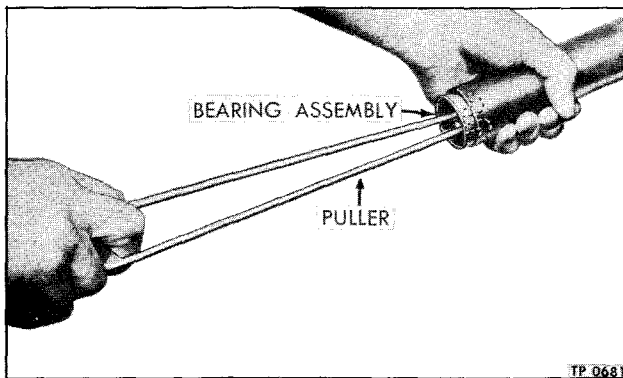


Figure 4—Upper Shaft Bearing Removal

1. Remove lever shaft adjusting screw lock nut and turn adjusting screw out a few turns.

2. Place pan under assembly to catch lubricant; then remove housing side cover and gasket.

3. After lubricant has drained out of housing, make sure outer end of lever shaft is free from any burrs which might damage bushings. Withdraw lever shaft assembly from housing.

4. To disassemble lever shaft assembly, bend prong of lock washers away from stud nuts and remove stud nuts. Remove bearing inner races, bearing rollers, and studs from bearing outer races; then press outer races out of lever shaft.

5. Remove four socket head screws attaching universal joint upper housing to lower housing. Lift universal joint upper housing and upper jacket tube assembly off upper shaft.

6. Remove shaft bearing assembly from upper jacket tube, using puller similar to that shown in figure 4.

7. Loosen clamp bolt which attaches universal joint assembly to upper end of cam and shaft assembly. Remove universal joint and upper shaft as an assembly. Remove Woodruff key. Loosen clamp bolt attaching universal joint to upper shaft; then remove universal joint from shaft.

8. Remove four bolts attaching gear housing upper cover to gear housing; then remove cover and lower jacket tube assembly from gear housing. Universal joint lower cover and gear housing upper cover are welded to lower jacket tube. Save shims used between gear housing cover and housing for use at assembly.

9. Remove lower jacket tube needle bearing assembly from upper end of tube, using puller similar to that shown in figure 4.

10. Pull cam and shaft assembly out through top of gear housing. Upper cam bearing is removed from gear housing with cam and shaft. Remove bearing from shaft.

11. Remove expansion plug from lower end of gear housing; then remove lower cam bearing from gear housing.

CLEANING AND INSPECTION (Figs. 5 and 6)

Clean all parts thoroughly in clean gasoline or other suitable cleaning fluid. Soak cam bearing assembly, and lever shaft stud bearings in cleaner to dissolve any particles of hard grease. When all parts are clean, perform following operations:

1. Inspect cam bearings for excessive wear, pitted balls, or broken or damaged retainers. If any of these conditions are found, replace bearing.

2. Examine stud roller bearings for pitting, chips, or broken rollers. If any rollers have to be replaced, it will be necessary to replace complete set of rollers. Satisfactory operation cannot be obtained if old and new rollers are installed in same assembly.

STEERING GEAR

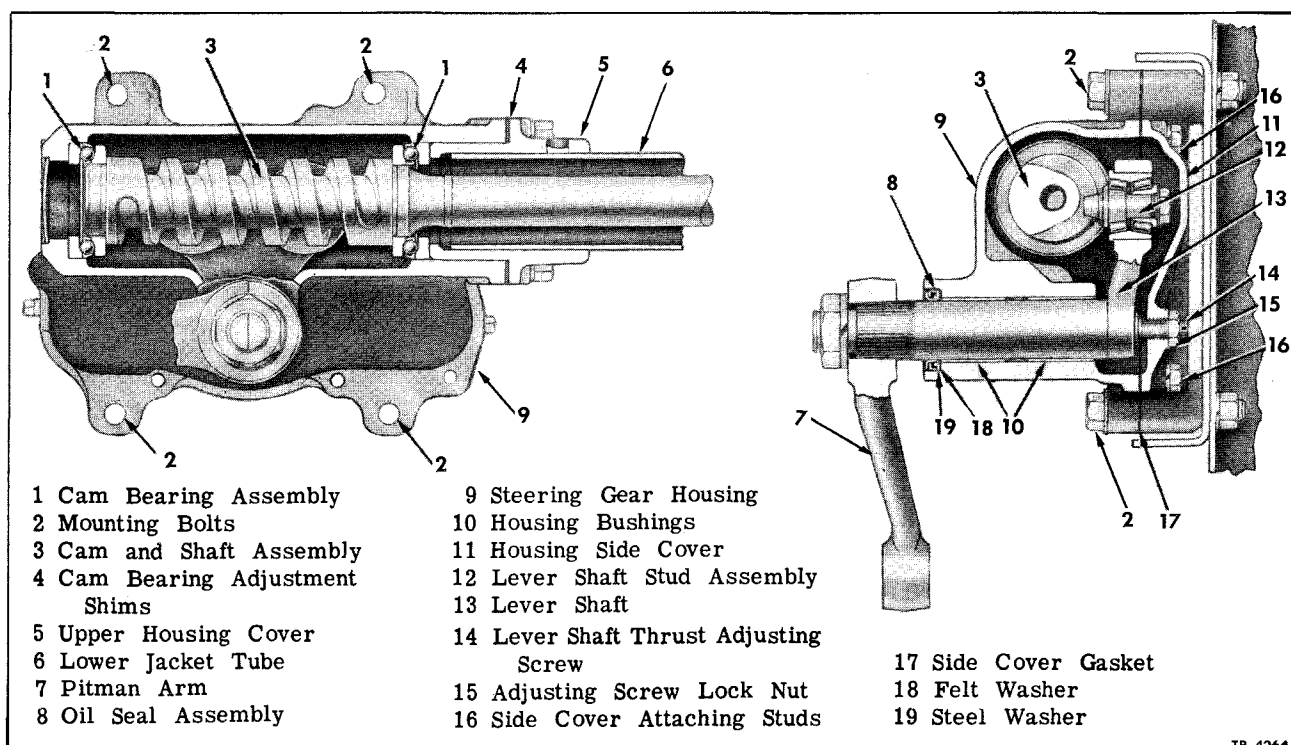


Figure 5—Steering Gear Assembly

3. Check helical cut grooves of cam and shaft for roughness. Grooves must be smooth and free from scores. Check shaft for bent or sprung condition.

4. Conical contact surfaces of lever shaft studs, which ride in cam grooves, must be smooth and round; however, small flat spots may be disregarded.

5. Check action of all rollers in lower shaft roller bearing assembly. If roller action is unsatisfactory, rollers show signs of wear, or retainers are damaged, new bearing assembly should be installed.

6. Lever shaft and Pitman arm should be carefully inspected to make sure parts are not bent or twisted and that splines are in good condition.

7. Insert lever shaft in gear housing and check clearance between shaft and housing bushings. If clearance is excessive and diameter of lever shaft is within limits given in "Specifications" at end of this section, bushings should be replaced. When installing new bushings, press bushings into housing until positioned as shown in figure 5.

8. Check action of universal joint. If action is not smooth and free, universal joint should be disassembled, cleaned, and inspected for defective parts which would impair action.

9. Inspect gear housing and housing side cov-

er for cracks, distortion, and condition of all tapped holes. Replace parts, if unfit for further service.

STEERING GEAR ASSEMBLY

Assembly of steering gear parts must not be attempted in dirty surroundings. Parts must be kept absolutely clean, since even small particles of dirt in working parts of steering gear can cause excessive wear. Referring to figures 5 and 6, assemble steering gear as follows:

1. Insert lever shaft oil seal steel washer and cork gasket into gear housing; then press oil seal into housing until seated solidly against gasket. Oil seal must be positioned with lip pointing inward.

NOTE: Use of a new oil seal is recommended, but old seal may be used if in good condition.

2. Assemble lever shaft assembly and adjust stud roller bearing units, as directed under "Adjusting Stud Roller Bearing Units," earlier.

3. Install lower cam bearing assembly in gear housing, making sure lower race seats solidly in housing. Install new expansion plug in lower end of housing.

4. Install upper cam bearing assembly on cam and shaft assembly; then place cam and shaft assembly in gear housing.

STEERING GEAR

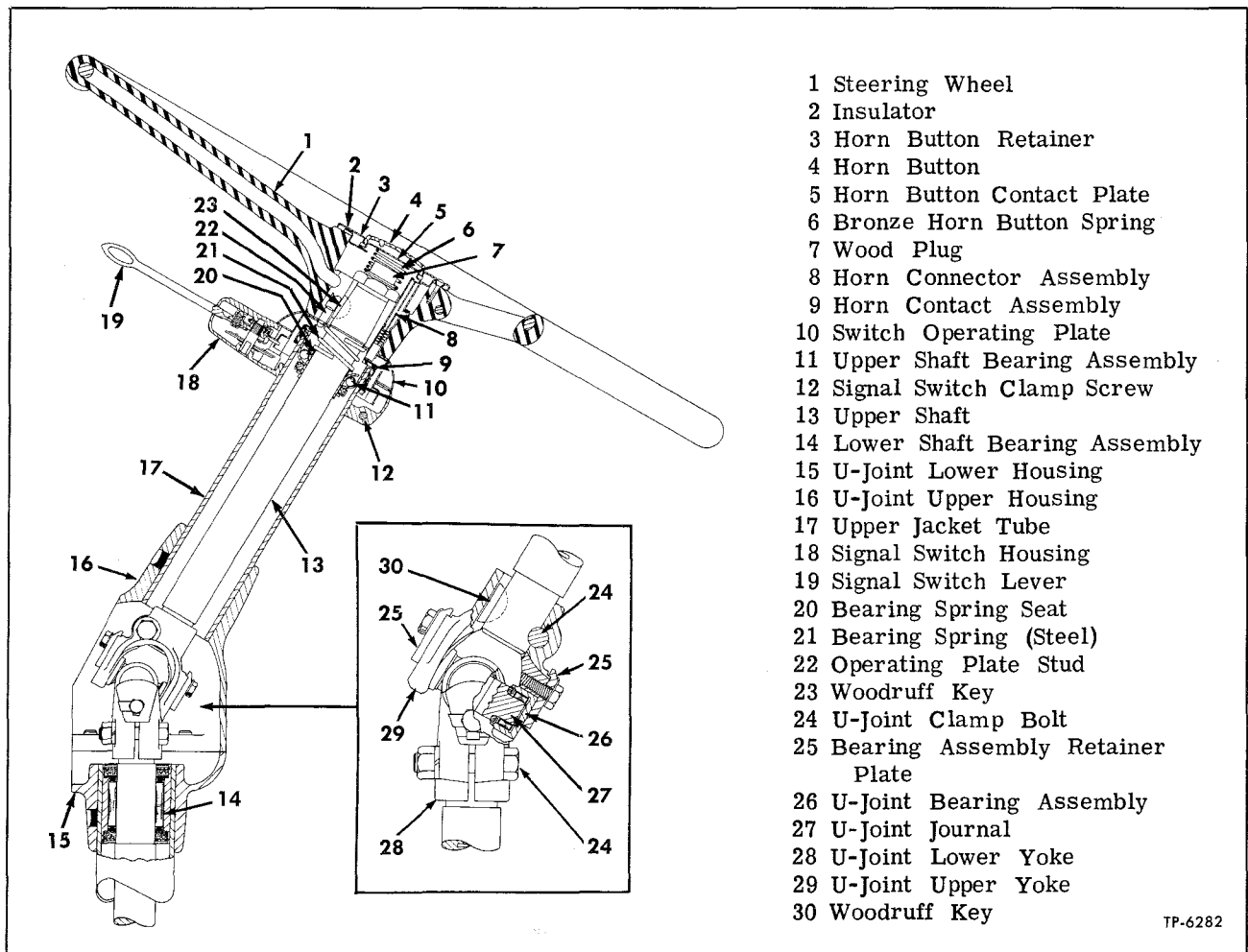


Figure 6—Universal Joint Assembly and Steering Wheel Installation

5. Place lower jacket tube assembly over cam and shaft assembly, using shims removed at disassembly between housing upper cover and gear housing. Install and tighten four bolts which attach housing upper cover to gear housing. Use new lock washers. Install lower shaft upper bearing assembly in upper end of lower jacket tube, pressing in until top of bearing is flush with top of lower jacket tube.

6. Install universal joint assembly on lower end of upper shaft, using Woodruff key and clamp bolt. Insert Woodruff key in upper end of cam and shaft assembly, position universal joint lower yoke on shaft; then install clamp bolt and tighten firmly.

7. Install upper shaft bearing assembly in upper jacket tube, pressing bearing into tube until flange seats against end of tube.

8. Slide upper jacket tube and universal joint upper housing over upper shaft. Position universal joint upper housing cover on lower housing, install and tighten firmly four socket head screws.

9. Slide lever shaft into gear housing, being careful not to damage bushings and oil seal.

10. Place new side cover gasket on gear housing, position side cover on housing; then install and tighten attaching cap screws, using new lock washers.

11. Fill gear housing with lubricant specified in LUBRICATION (SEC. 13).

12. Temporarily install steering wheel and make "Cam Bearing Adjustment" and "Lever Shaft Thrust Adjustment," as directed earlier.

STEERING GEAR INSTALLATION

1. Insert steering column upward through floor of vehicle and raise housing into position on understructure. Install four mounting bolts, with heads toward frame; then place new plain washers and new lock washers on bolts and install nuts. Tighten nuts securely.

2. Install rubber seal and closure plates around steering column at floor. Attach plates to floor with screws.

STEERING GEAR

3. Position bearing spring seat on upper shaft and against bearing. Coat inside of rubber on horn contact assembly with hydraulic brake fluid. Slide directional signal switch and horn contact assembly over upper jacket tube, positioning switch an inch or two below normal installed position. Rotate horn connector so that horn wire runs straight through opening in switch housing; then press connector firmly into place on upper jacket tube.

4. Position steel bearing spring on upper shaft; then place Woodruff Key in shaft keyway. Position operating plate to steering wheel, with plate studs engaged with holes in steering wheel. Make sure connector sleeve holes in steering wheel and operating plate are aligned. Holding plate and steering wheel together, position parts on upper shaft. Install steering wheel retaining nuts and tighten securely.

5. Install wood plug in upper shaft. Position horn connector assembly in steering wheel, in-

serting connector sleeve carefully through wheel and operating plate. Position bronze spring over wood plug; then install contact plate, horn button cap, insulator, and retainer. Attach retainer with three screws. Slide directional signal switch upward on jacket tube, turn steering wheel to make sure operating plate does not interfere with switch; then tighten switch housing clamp screw firmly. Check operation of directional signal switch and horn.

6. Place vehicle wheels in straight-ahead position and turn steering wheel to center of steering gear travel. Install Pitman arm on end of lever shaft, aligning mark on arm with mark on shaft. Install new lock washer, then secure Pitman arm with nut. Checking front end alignment at this time is also recommended.

7. Assemble and connect drag link to Pitman arm as instructed later under "Steering Drag Link."

STEERING DRAG LINK

Steering drag link assembly is three piece type, comprised of drag link and two end assemblies. As shown in figure 7, drag link ends are roller bearing type and incorporate an adjustment feature which automatically compensates for wear on bearing surfaces. Both end assemblies are identical, except that end assembly at Pitman arm screws onto drag link to provide for length adjustment, while end at axle is integral with link. Drag link end at Pitman arm is retained on drag link with clamp bolts.

MAINTENANCE

Linkage between steering gear and front axle definitely affects steering action if parts are out of adjustment, bent, or twisted. Check steering geometry and front wheel alignment when steering linkage is repaired or replaced.

Drag link end stud nuts must be kept tight or stud holes in steering arm and Pitman arm may become enlarged as a result of excessive looseness. Subsequent tightening of stud nuts may draw studs into arms so far that dust cover parts may be damaged during sharp turns.

Drag link ends are equipped with lubrication fittings and should be lubricated as directed in LUBRICATION (SEC. 13).

LENGTH ADJUSTMENT

It should not be necessary to alter length of drag link except when new link is installed or when removable end has been removed for over-

haul. If necessary to adjust drag link length, proceed as follows:

1. Connect rear drag link end to axle steering arm. Be sure drag link end is lubricated.

2. Locate center of steering movement by turning steering wheel from right extreme to left extreme, counting the number of turns; then back up exactly half way. With front wheels in straight-ahead position, front ball socket of drag link should fit in Pitman arm without changing position of Pitman arm or front wheels.

3. If parts do not assemble correctly, first check all linkage for bends or distortion. If none of the drag link parts are found to be bent or

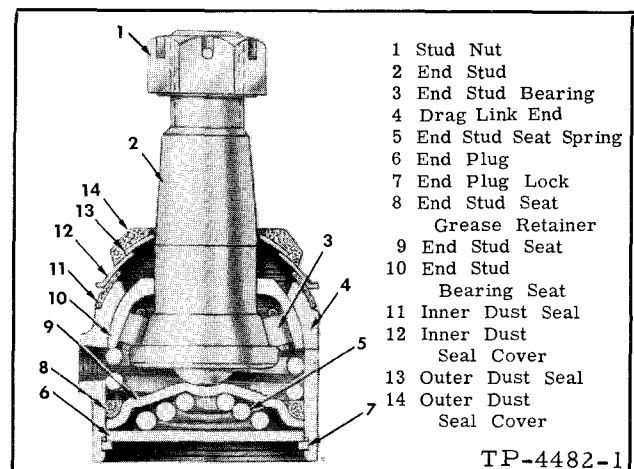


Figure 7—Drag Link End Assembly

STEERING GEAR

twisted, loosen clamp bolts; then turn front drag link end enough to permit installation of end stud in Pitman arm without twist or bind.

4. Tighten clamp bolts firmly; then test adjustment. Front wheels should turn from right to left extremes without noticeable binding.

DRAG LINK END REPAIR

Normal wear on bearing surfaces in drag link end will result in increased overall height of assembly. If excessive play is noted, drag link ends must be removed and disassembled for replacement of worn parts.

REMOVAL AND DISASSEMBLY (Fig. 7)

1. Disconnect drag link ends from steering and Pitman arms, by removing cotter pins and nuts and driving studs out of arms.

2. Loosen clamp bolt nuts and unscrew drag link end from drag link (at Pitman arm end).

3. Remove outer dust seal cover (14), outer dust seal (13), inner dust seal cover (12), and inner dust seal (11) from end stud (2).

4. Pry end plug lock (7) out of drag link end (4); then remove end plug (6), end stud seat spring (5), end stud seat (9), grease retainer (8), end stud (2), end stud bearing (3), and end stud bearing seat (10) from drag link end.

CLEANING AND INSPECTION (Fig. 7)

1. Immerse all parts, except outer dust seal cover (14), and inner dust seal (11), in a suitable cleaning fluid. Use a stiff bristle brush as required, and clean all parts thoroughly.

2. Check all parts for wear or corrosion and discard parts that are badly damaged.

3. Check tension of end stud seat spring (5). Discard spring if tension is not within limits given in "Specifications," at end of this section.

4. Carefully inspect rollers in end stud bearing assembly (3) for roughness or flaking. If rollers will not rotate freely in retainer, bearing assembly should be replaced.

ASSEMBLY AND INSPECTION (Fig. 7)

Keep all parts clean when performing assembly operations. If dirt or grit is allowed to get into drag link end when assembling, premature and excessive parts wear will result.

1. Lubricate all parts with lubricant specified in LUBRICATION (SEC. 13). Place end stud bearing seat (10) on end stud (2).

2. Insert stud and bearing assembly into drag link end (4); then press grease retainer (8) over end stud seat (9). Place stud seat in drag link end; then install end stud seat spring (5), and end plug (6). Secure parts in drag link end (4) with end plug lock (7).

3. Install inner dust seal (11), inner dust seal cover (12), outer dust seal (13), and outer dust seal cover on threaded end of stud.

4. Install drag link end assembly on drag link, but do not tighten clamp bolt nuts. Clamp bolts must be installed with nuts on end stud side.

5. Place drag link in position on vehicle, then connect end stud to steering arm at axle.

6. Adjust drag link length as previously directed under "Length Adjustment;" then lubricate, as directed in LUBRICATION (SEC. 13).

SPECIFICATIONS

Make Ross Gear & Tool Co.
Type Cam & Roller - Twin Lever
Gear Ratio 19.5 to 1
Steering Wheel Diameter 22"

CLEARANCE

Housing Dia. at Lever Shaft Bush. . . 1.748 - 1.750"
Lever Shaft Bushing O.D. 1.751 - 1.752"
Lever Shaft Bushing I.D. 1.6235 - 1.6250"
Lever Shaft Dia. 1.622 - 1.623"
Clearance - Bush. to Shaft. . . . 0.0005 - 0.003"
Clearance - Bush. to
Housing 0.001 - 0.004" Tight
Lever Shaft Stud Bearing
Outer Race - O.D. 1.6875 - 1.6880"
Lever Shaft Stud Hole Dia. 1.68675 - 1.686"
Clearance - Race to Shaft 0.00075 - 0.002" Tight
Housing Dia. at Cam Bearing
Seats 2.750 - 2.752"
Cam Bearing Outer Race Dia. . . . 2.748 - 2.749"
Clearance - Race to Housing 0.001 - 0.004"

ADJUSTMENTS

Cam Bearings

Adjustment Type Shims
Shim Sizes Available... 0.002, 0.003, & 0.010"
Adjust to Slight Drag (see text)

Lever Shaft Thrust

Adjustment Type..... Adjuster Screw
Adjust to Slight Drag (see text)

Lever Shaft Stud Bearings

Adjustment Type..... Adjuster Nut
Adjust to (See Text)

STEERING DRAG LINK

Type Adjustable Length
Stud Centers 49-5/8"

Stud Seat Spring

Free Length 3/4"
Lbs. Pressure at 1/2" 350 - 400 lbs.
Solid Height 3/8"

Transmission

Mechanical transmission (fig. 1), has four forward speeds and one reverse. All mainshaft, reverse idler, and countershaft gears have helical cut teeth and are in constant mesh. Interlocking (sliding) clutches with spur teeth on inner diameter slide on corresponding teeth on clutch gears.

Power is transmitted from transmission to propeller shaft through a spiral bevel gear angle drive unit which comprises part of transmission assembly.

Transmission is attached to and supported by engine clutch housing. When necessary to service transmission, access to unit is gained through engine compartment doors at rear of the vehicle (fig. 6).

The terms "Front" and "Rear" as used in following description and illustrations do not apply to the mounted position of transmission in coach. Following the common usage of those terms - "Front" applies to clutch end of transmission, while "Rear" applies to propeller shaft end. Key numbers in text refer to figures 1 and 2.

MAINSHAFT AND GEARS

Mainshaft (32) is supported at rear end by opposed tapered roller bearings (30 and 33) mounted in angle drive case end cover (27). Mainshaft center roller bearing (47) mounted in main case (79) directly in front of bevel pinion (43), supports mainshaft at that point. Front of mainshaft is supported by main drive gear pilot roller bearing (81) mounted in pocket of main drive gear (85). Main drive gear is supported in main case (79) by single row ball bearing (83).

Mainshaft 3rd and 4th speed clutch gear (93) is mounted on splined portion of mainshaft and held in place with mainshaft gears retaining nut (80) and lock washer (92). First and 2nd speed clutch gear is integral with mainshaft.

Mainshaft 1st (9), 2nd (101), and 3rd (97) speed constant mesh gears are each mounted on double row needle bearings. Rows of bearings are separated by spacers.

COUNTERSHAFT AND GEARS

Countershaft (56) is supported at rear by single row ball bearing (53) held on shaft with two lock nuts (54 and 57) and lock washer (55). Front end of shaft is supported on countershaft front roller bearing (75) which is prevented from coming out of case by clutch housing (91). Inner race of roll-

er bearing (75) is held on shaft by countershaft front bearing nut (77) and retaining washer (76).

Countershaft drive gear (71) and countershaft 3rd speed gear (68) are keyed to shaft and separated by spacer (72). Countershaft 2nd speed gear (65) and countershaft clutch gear (62) are integral with shaft.

Countershaft 1st speed gear (61) is not keyed to shaft, but is carried on bronze bushing (60) and is driven by countershaft sliding clutch (63) carried on countershaft clutch gear. Countershaft sliding clutch is operated by reverse shift fork and is engaged in all forward speeds.

REVERSE IDLER GEAR

Reverse idler driving and driven gears (64 and 67) are mounted on roller bearings, with two bearings in each gear separated by spacers.

Reverse idler gears are separate, revolving independently of each other in all forward speeds. Reverse idler driven gear is in constant mesh with countershaft 2nd speed gear (65) and reverse idler driving gear (64) is in constant mesh with mainshaft 1st speed gear (9). Reverse idler sliding clutch (66) is carried on hub of reverse idler driving gear, and engages both gears during reverse operation.

OIL PUMP

Transmission lubricant is circulated to various points by a conventional gear type oil pump mounted on rear side of angle drive case. Oil pump drive is accomplished by fitting end of oil pump shaft (51) into rear end of countershaft (56).

Oil pump drive gear (50) hubs project on both sides and fit into oil pump housing (52). Oil pump driven gear is bushed and turns on shaft (46) pressed into oil pump cover (44). Pump is fitted with spring loaded pressure relief valve, consisting of a ball (39) and spring (40) held in place by screw type plug (41).

SHIFTING MECHANISM

Selection of transmission gear is made by conventional shifting lever. Gearshift lever is mounted in a tower attached under floor near driver's seat. Two shift slides in base of gearshift lever tower are connected with control rods which run from front to rear of coach below floor. Adjustable yokes are provided at points where forward rods are attached to shift slides in lever

TRANSMISSION

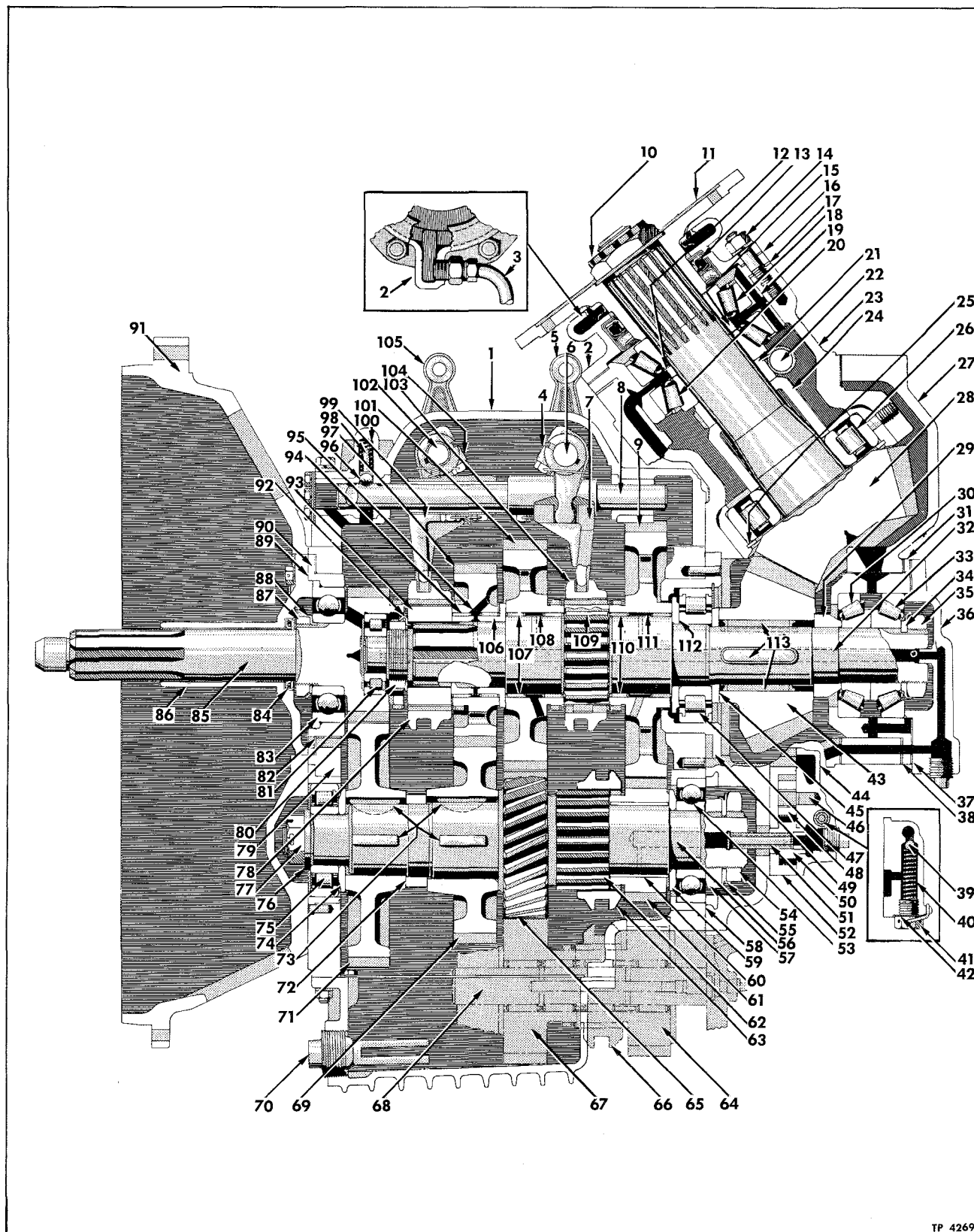


Figure 1—Sectional View of Transmission

TRANSMISSION

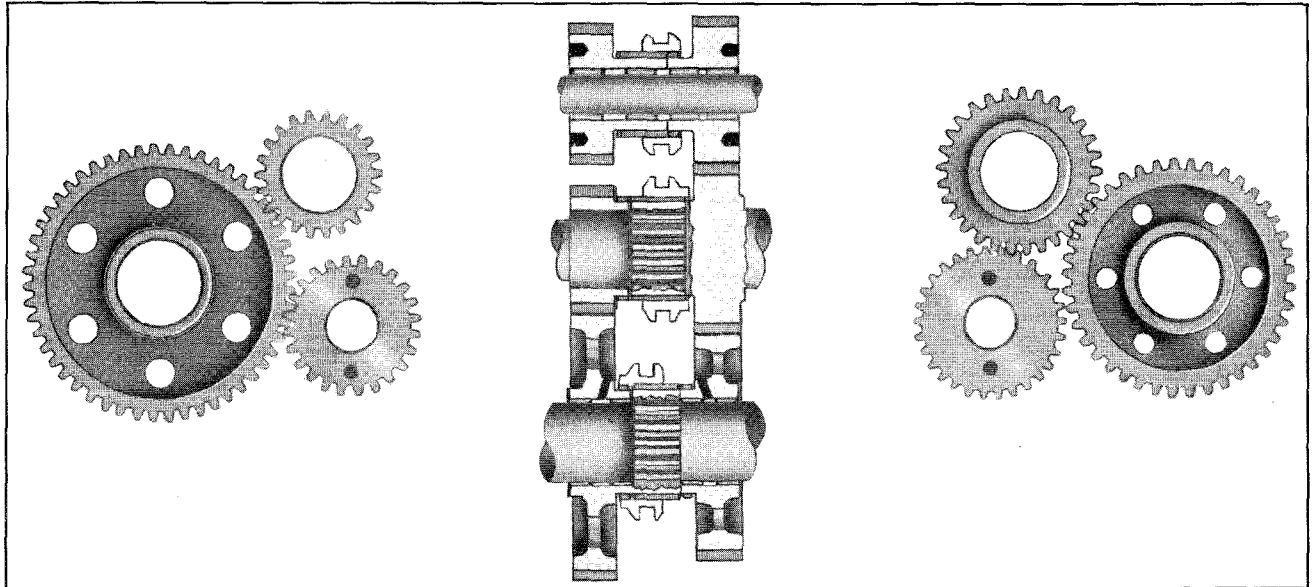


Figure 2—Arrangement of Mainshaft, Countershaft, and Reverse Idler Gears, and Sliding Clutches for Reverse Operation

1 Main Case Cover	38 Shims	78 3rd and 4th Speed Sliding Clutch
2 Bearing Cap	39 Oil Pump Relief Valve Ball	79 Transmission Main Case
3 Bearing Cap Drain Tube	40 Relief Valve Spring	80 Mainshaft Nut
4 1st, 2nd, and Reverse Shift Finger	41 Relief Valve Plug	81 Mainshaft Pilot Bearing
5 1st, 2nd, and Reverse Shift Lever	42 Pressure Relief Valve Plug Washer	82 Bearing Retainer Gasket
6 1st, 2nd, and Reverse Shift Shaft	43 Bevel Pinion	83 Main Drive Gear Bearing
7 1st and 2nd Speed Shift Fork	44 Oil Pump Cover	84 Oil Seal
8 1st, 2nd, and Reverse Shift Rod	45 Bevel Pinion Front Spacer	85 Main Drive Gear
9 Mainshaft 1st Speed Gear	46 Oil Pump Driven Gear Shaft	86 Main Drive Gear Bearing Cap
10 Propeller Shaft Flange Nut	47 Mainshaft Center Bearing	87 Bearing Lock Nut
11 Propeller Shaft Flange	48 Oil Pump Driven Gear	88 Lock Washer
12 Shims	49 Mainshaft Center Bearing Retainer	89 Shims
13 Oil Seal	50 Oil Pump Drive Gear	90 Bearing Retainer
14 Bearing Cap Stud Nut	51 Oil Pump Drive Shaft	91 Clutch Housing
15 Bearing Spacer	52 Oil Pump Housing	92 Nut Lock Washer
16 Gasket	53 Countershaft Rear Bearing	93 3rd and 4th Speed Clutch Gear
17 Shims	54 Outer Nut	94 3rd Speed Gear Bearings
18 Angle Drive Outer Tapered Bearing	55 Lock Washer	95 Spacer
19 Bearing Retainer	56 Countershaft	96 Poppet Ball
20 Angle Drive Inner Tapered Bearing	57 Inner Lock Nut	97 3rd Speed Gear
21 Speedometer Drive Gear	58 Countershaft Rear Bearing Retainer	98 Plunger
22 Speedometer Driven Gear	59 Countershaft 1st Speed Gear Thrust Washer	99 3rd and 4th Speed Shift Fork
23 Angle Drive Case	60 Countershaft 1st Speed Gear Bushing	100 Spring
24 Spacer	61 Countershaft 1st Speed Gear	101 Mainshaft 2nd Speed Gear
25 Snap Ring	62 Countershaft Clutch Gear	102 3rd and 4th Speed Shift Shaft
26 Angle Drive Gear Roller Bearing	63 Countershaft Sliding Clutch	103 1st and 2nd Speed Sliding Clutch
27 Angle Drive Case Cover	64 Reverse Idler Drive Gear	104 3rd and 4th Speed Shift Finger
28 Angle Drive Gear and Shaft	65 Countershaft 2nd Speed Gear	105 3rd and 4th Speed Shift Lever
29 Bevel Pinion Rear Spacer	66 Reverse Idler Sliding Clutch	106 3rd and 4th Speed Gear Thrust Collar
30 Mainshaft Inner Rear Bearing	67 Reverse Idler Driven Gear	107 2nd Speed Gear Bearing
31 Bearing Retainer	68 Reverse Idler Shaft	108 Bearing Spacer
32 Mainshaft	69 3rd Speed Countershaft Gear	109 1st and 2nd Speed Clutch Gear
33 Mainshaft Outer Rear Bearing	70 Magnetic Drain Plug	110 1st Speed Gear Bearings
34 Lock Washer	71 Countershaft Drive Gear	111 Bearing Spacer
35 Mainshaft Rear Bearing Nut	72 Spacer	112 1st Speed Gear Thrust Washer
36 Mainshaft Rear Bearing Cap	73 Countershaft Gear Key	113 Bevel Pinion Key
37 Shims	74 Drive Gear Retaining Washer	
	75 Countershaft Front Bearing	
	76 Bearing Retaining Washer	
	77 Countershaft Bearing Retaining Nut	

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Legend for Figures 1 and 2

TRANSMISSION

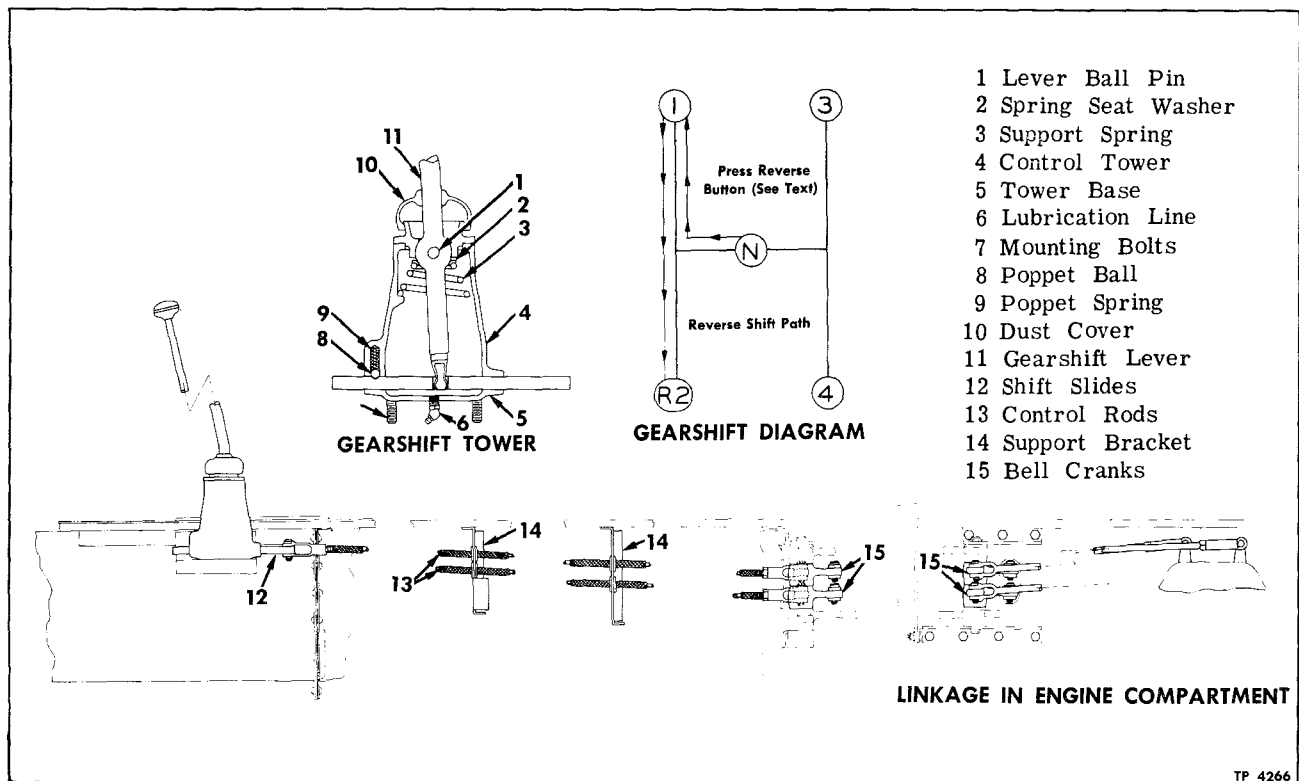


Figure 3—Transmission Controls and Linkage

tower and also where rear rods are connected with levers at transmission.

When shift is made for any one of four forward speeds (fig. 3) the movement of shift lever is transmitted to transmission through various rods, levers, and bell cranks.

Transmission control rods from shifting lever to bulkhead are supported as illustrated in figure 3. First, second, and reverse gears are controlled by the right-hand rod and third and fourth speed by the left-hand rod. Rods pass through loom packed with commercial graphite.

Rods and loom are supported in rubber grommets in support brackets. Make all control rod adjustments, with controls in neutral. Keep yoke pins well lubricated -- refer to LUBRICATION CHART in SECTION 13.

REVERSE SOLENOID AND RELAY

The reverse solenoid, mounted on the transmission assembly is used to furnish pulling force to move shift finger into engagement with reverse speed shift fork.

Reverse solenoid has two coils, one known as a pulling coil and the other referred to as holding coil. Electrical circuit to solenoid is completed by means of solenoid relay mounted on engine

compartment panel. Relay is in turn controlled by reverse switch button at panel to the left of driver. Relay control circuit is protected by a circuit breaker located in circuit breaker panel at left of driver.

When gearshift lever is in 1st speed position the shift finger (19 fig. 7) is in line with notch in reverse speed shift fork, hence pressing the reverse button at this time causes reverse solenoid to operate, thereby moving finger into engagement with reverse shift fork.

As gearshift lever is moved through reverse shift path (fig. 3) the reverse idler drive and driven gears are locked together by clutch and at same time countershaft 1st speed gear is disengaged from countershaft to become an idler gear for reverse operation.

Both coils in reverse solenoid (fig. 5) are energized to move the shift finger in transmission, but as solenoid plunger reaches end of its travel it strikes a pin which opens a set of points thereby breaking circuit through pulling coil. The holding coil remains energized however and will hold the solenoid plunger "in" as long as driver presses the reverse switch button. Refer to Engine Control and Generator wiring diagram in back of manual for arrangement of wiring, junctions, and circuit breaker.

TRANSMISSION**OIL SEALS**

Spring loaded synthetic rubber type oil seals are used at main drive gear bearing cap (84) and at output shaft bearing cap (13). Spring loaded leather oil seals are used at three points on shift shafts in transmission cover. See figure 7, items 11, 16, and 26.

Before leather seals are installed, they should be soaked in "Neatsfoot" oil or warm engine oil until leather portion of seal is soft and pliable. This procedure will insure an efficient leak-proof seal and also assists in installation. Seal assemblies should be replaced in overhaul periods.

TRANSMISSION OPERATION

Forward speeds are shifted manually by means of shift lever interconnected to transmission shift tower by control rods and levers (fig. 3).

This section describes the path by which power flows through the transmission assembly as vehicle is operated. Shifting diagram shown in figure 3 may be referred to for gearshift lever position for each transmission speed.

FIRST SPEED

The 1st and 2nd speed sliding clutch (103) is engaged with mating teeth on mainshaft 1st speed gear (9). Power flow is from main drive gear (85) to countershaft drive gear (71), through countershaft (56) to countershaft 1st speed gear (61), to mainshaft 1st speed gear through sliding clutch (103) and clutch gear (109) to mainshaft (32), through mainshaft to angle drive gears and output shaft (28).

SECOND SPEED

First and 2nd speed sliding clutch (103) is engaged with mating teeth on mainshaft gear (101). Power flow is main drive gear (85) to countershaft drive gear (71), to 2nd speed gear (65), to mainshaft 2nd speed gear (101), to clutch (103) and clutch gear (109), to mainshaft (32), through mainshaft to angle drive gears and output shaft (28).

THIRD SPEED

The 3rd and 4th speed sliding clutch (78) is engaged with mating teeth on mainshaft 3rd speed gear (97). Power flow is from main drive gear (85) to countershaft drive gear (71), through countershaft (56) to countershaft 3rd speed gear (69) and through sliding clutch (78) and clutch gear (93) to mainshaft, through mainshaft to angle drive gears and output shaft (28).

FOURTH SPEED

The 3rd and 4th speed sliding clutch (78) is engaged with mating teeth at rear of main drive

gear (85). Power flow is directly through sliding clutch (78) and clutch gear (93) to mainshaft and to angle drive gears and output shaft (28).

REVERSE SPEED

Reverse speed is shifted manually using same controls as forward speeds, but is assisted by a solenoid mounted on transmission shift cover and controlled by a button mounted on coach body at left of driver.

To shift from neutral into reverse speed, move gear shift lever into first speed position engaging first speed gears. Refer to figure 1. Energize solenoid on transmission by pressing reverse button. Solenoid moves shift finger in transmission cover from first and second speed fork to reverse speed fork. Move gear shift lever into second position which moves reverse shift fork forward disengaging sliding clutch on countershaft and engaging sliding clutch on reverse idler gears. Control button must be held in depressed position until shift into reverse is complete.

For reverse operation, sliding clutches are positioned and gears are meshed as shown in figure 2. Power flow is: main drive gear (85) to countershaft drive gear (71), through countershaft to 2nd speed gear (65), to reverse idler driven gear (67) and driving gear (64), to mainshaft 1st speed gear (9), through sliding clutch (103) to mainshaft, to angle driver gears and output shaft.

MAINTENANCE ON VEHICLE

The light maintenance operations covered in this paragraph include items which should be periodically inspected and those minor repairs and adjustments which may be accomplished without removing transmission from vehicle.

TRANSMISSION CONTROL ROD ADJUSTMENT

Provisions are made for adjustment of control rod length by use of adjustable yokes. When replacing transmission or any of the control linkage, be sure linkage is adjusted as follows, before attempting to operate vehicle.

1. Place gearshift lever in neutral position; then move transmission gears into neutral position by operating levers (105 and 5 fig. 1).

2. Adjust control rod end yokes so that clevis pins can be inserted without moving rods or levers from neutral position. Make certain lock nuts are tightened after adjustment has been made.

INSPECTION AND LUBRICATION

At regular intervals inspect for looseness of transmission mounting bolts, also transmission cover retaining bolts. Inspect for evidence of lubricant leakage at bearing caps and at filler and drain plugs. End bearing cap drain tube (3) should

TRANSMISSION

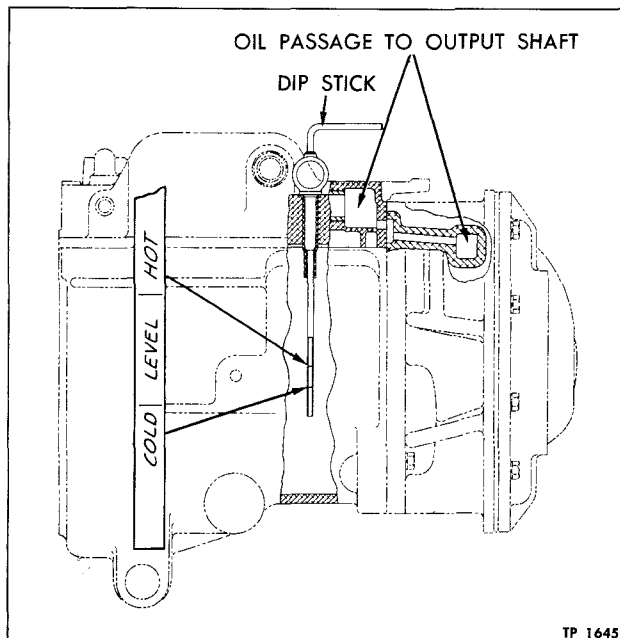


Figure 4—Check Lubricant on Dipstick

be inspected and kept free from dirt and grease (fig. 1).

Refer to LUBRICATION (SEC. 13) for recommendations on type and quantity of lubricant to use and also for recommended lubrication intervals.

A sump at bottom of main case is equipped with magnetic type drain plug. This plug should be removed and cleaned at draining periods. Angle drive case is also equipped with magnetic type plug which should be cleaned at regular periods.

"Hot" and "Cold" levels down on dip stick (fig. 4) refer to lubricant level when lubricant is hot or cold, respectively.

REVERSE SOLENOID LINKAGE ADJUSTMENT

Whenever the reverse solenoid has been removed, or if difficulty is experienced when shifting transmission into reverse speed, the following procedure will properly adjust the solenoid linkage.

1. Make certain transmission control rod linkage is correctly adjusted.
2. Place gear shift lever in first speed position.
3. Remove cover from rear of reverse solenoid, and inspect contact points. If points are burned or pitted, dress with a fine cut point file.
4. Manually shift reverse solenoid lever into reverse speed position.
5. Adjust lock nuts on solenoid link screw so that solenoid points just break, with the 1st, 2nd and reverse speed shift shaft moved fully into reverse speed position (fig. 5).

TRANSMISSION REPLACEMENT

TRANSMISSION REMOVAL

(Key numbers refer to Fig. 6)

Refer to figure 6 for transmission installation view. Transmission may be removed from vehicle as a unit without removing complete power plant, in following manner:

1. Disconnect propeller shaft at axle by removing flange bolts, then unscrew dust cap at slip joint, and remove propeller shaft.
2. Remove transmission dust shield (5).
3. Remove diagonal strut (6).

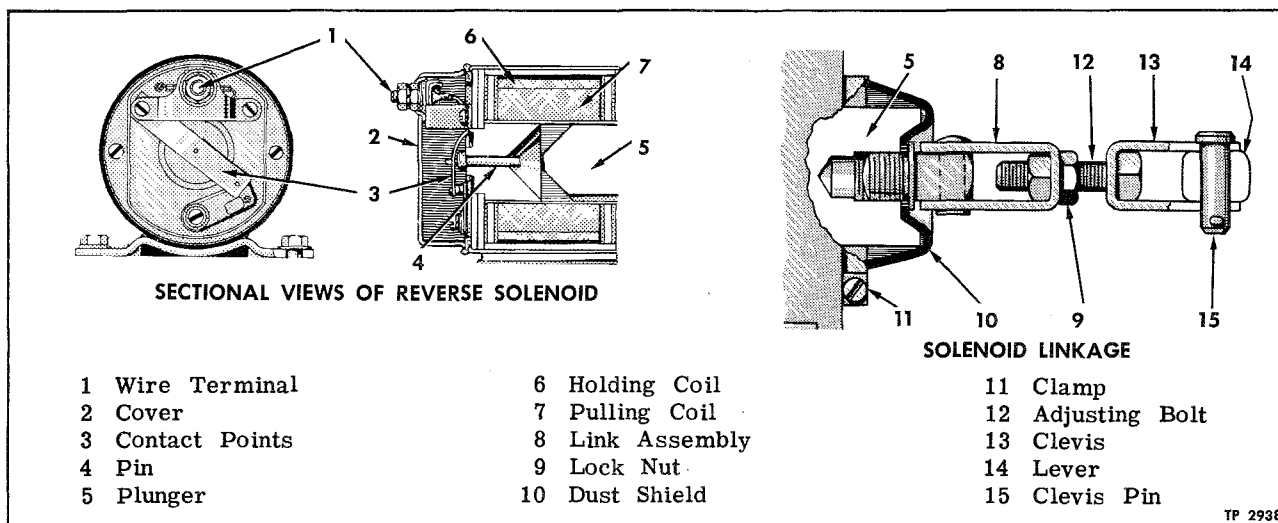


Figure 5—Reverse Solenoid and Linkage

TRANSMISSION

6. Disconnect hand brake pull rod and shift rods (1) from shift levers at transmission.
7. Unhook clutch return spring and disconnect clutch control rod (2) from clutch lever.
8. Disconnect wiring from speedometer sending unit (7) and reverse solenoid (8).
9. Place suitable dolly or hoist under transmission. Remove transmission mounting bolts (9), withdraw transmission through compartment right-hand side door.

CLEANING

After transmission is removed from vehicle, reverse solenoid and linkage should be removed. Exterior of transmission should be thoroughly cleaned with a suitable solvent to loosen and remove all accumulated road dirt and grime. After all dirt and other foreign material has been removed, rinse with gasoline and blow dry with compressed air.

NOTE: The use of caustic cleaning compounds should be avoided due to their harmful effect on aluminum.

TRANSMISSION INSTALLATION

(Key numbers refer to Fig. 6).

1. Refer to figure 6 for transmission installation view. Coat clutch shaft splines sparingly with lubricant as directed in LUBRICATION (SEC. 13 of the manual). Install clutch release parts in clutch housing if they have been removed. Check the finger adjustment and also clean clutch bell housing and transmission bell housing. Refer to CLUTCH (SEC. 5) for clutch release mechanism information.
2. Support transmission on suitable dolly or hoist with splined clutch shaft in alignment with clutch disc hub.
3. Move transmission assembly into position at engine and bolt clutch housing to flywheel housing.
4. Connect wiring to speedometer sending unit (7) and reverse solenoid (8).
5. Connect clutch control rod (2) to clutch lever then connect clutch return spring.
6. Connect shift rods (1) to shift levers then connect hand brake pull rod.
7. Install diagonal strut (6).
8. Install transmission dust shield (5).
9. Assemble propeller shaft at slip joint and rear axle.

TRANSMISSION CONTROLS

REMOTE CONTROL REMOVAL AND DIS-ASSEMBLY (Key numbers Refer to Fig. 3)

1. Disconnect control rods (13) from shift slides (12) and lubrication line (6) from tower base (5).

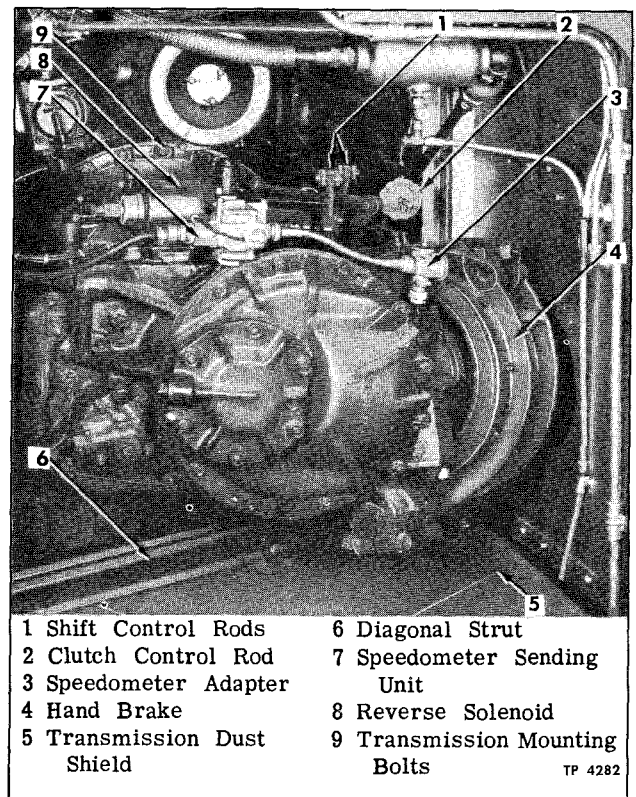


Figure 6—Transmission Installed in Coach

2. Remove nuts and lock washers from remote control mounting bolts (7).
3. Remove screws in remote control floor plate and remove plate and seal.
4. Remove remote control assembly from vehicle.
5. Remove four mounting bolts from control tower to remove tower base (5), then lift out shift slides (12), poppet balls (8), and springs (9).
6. Slide dust cover (10) upward on shift lever (11), remove four tower top to control tower bolts. Lift shift lever and top assembly from control tower and remove lever ball pin (1).
7. Lift out support spring seat washer (2).
8. Pry support spring (3) off ledges (lugs) inside tower and remove from assembly.

REMOTE CONTROL ASSEMBLY AND INSTALLATION (Key numbers Refer to Fig. 3)

1. Install support spring (3) pushing spring into tower (4) until lower coil of spring locks behind ledges inside of tower.
2. Install support spring seat washer.
3. Install lever ball pin (1) then position shift lever assembly (11) in control tower (4), and install four bolts. Position dust cover (10) at tower top.
4. Position poppet springs, balls, and shift

TRANSMISSION

slides, then assemble tower base (5) with four mounting bolts.

5. Position remote control assembly in vehicle, and install lock washers and nuts on mounting bolts.

6. Attach lubrication line (6) to shift tower base.

7. Attach control rods (13) to shift slides (12) adjusting control rods if necessary.

8. Install control tower floor plate seal and floor plate.

TRANSMISSION DISASSEMBLY

(Refer to Fig. 1)

Procedures for disassembling and assembling transmission as outlined in succeeding paragraphs should be followed carefully to accomplish overhaul of transmission with minimum effort and time. In addition to the tools, necessary receptacles for cleaning the parts and air pressure for blowing out particles of dirt should be available. Parts should be cleaned thoroughly for inspection and reassembly.

Mount unit rigidly on a suitable stand and proceed as follows:

1. Remove main case cover (1) with shift forks and shafts. Remove oil pump from rear of transmission.

2. Remove mainshaft rear bearing cap (36). Cap has two slots at outer edge so that screw driver may be used to pry cap from retainer (31). Do not use extreme force when prying cap. Note quantity of shims (37) used between cap and retainer. Tag shims so that original pack may be used when reassembling.

3. Lock mainshaft by engaging both first and third speed gears.

4. Straighten out lips of lock washer (34) and remove mainshaft rear bearing nut (35) with special wrench (Tool No. CS 1072). This nut has left-hand threads and is marked with letters L.H. to distinguish it from countershaft nut.

5. Remove rear bearing retainer (31) with bearings. Retainer is provided with tapped holes in which puller screws may be used. Note quantity of shims (38) used between retainer and angle drive case cover (27). Tag shims so that original pack may be used when reassembling.

6. Remove angle drive case cover (27). Two dowel pins are used to locate angle drive case cover to angle drive case (23).

7. Remove angle drive case with angle drive gear and shaft assembly (28) from main case (79).

8. Remove lock wire and stud nuts which attach clutch housing to transmission; then remove clutch housing, together with clutch release parts.

9. Tapped hole in rear end of reverse idler shaft is provided to withdraw shaft from case.

As shaft is withdrawn, gears, bearings, spacers and thrust washers will be stripped from shaft.

10. Pull mainshaft bevel pinion (43) from mainshaft with special puller (Tool No. CS 1048). Puller must grasp pinion firmly or pinion teeth will be damaged. Spacer (29) will be removed as pinion is pulled from mainshaft.

11. Remove mainshaft center bearing retainer (49) with bearing (47) and thrust washer (112). Retainer has slots on outer edge so that screw driver may be used to assist in its removal. Bearing and thrust washer may be pressed from retainer if necessary after removing bearing snap ring.

12. Remove main drive gear bearing cap (86) and oil seal (84).

13. Remove main drive gear (85) with bearing (83) and bearing retainer (90). Pry lightly between main drive gear and third and fourth speed sliding clutch (93) to start drive gear bearing retainer from case. Remove pilot bearing (81) from mainshaft.

14. Tie mainshaft gears together to hold them in place while removing mainshaft from case. Lift mainshaft and gears from case.

15. Straighten lips of lock washer (55) and remove countershaft rear bearing lock nuts (54 and 57).

16. Force countershaft (56) towards rear until rear bearing retainer flange is exposed, then pull rear bearing (53) and retainer (58) from countershaft.

17. Remove first speed gear (61) and thrust washer (59) from countershaft through bearing hole in case.

18. Move countershaft towards rear until shaft clears front bearing (75), then remove countershaft with gears through top of case.

DISASSEMBLY OF SUBASSEMBLIES

REMOVING MAINSHAFT GEARS

1. Untie gears and remove first speed gear (9), first and second speed sliding clutch (103) and third and fourth speed clutch (78).

2. Raise tangs on lock washers (92) and remove lock nut (80) from end of mainshaft.

3. Balance of gears with thrust washers, bearings and spacers may be stripped from mainshaft.

REMOVING GEARS FROM COUNTERSHAFT.

1. Remove low speed gear sliding clutch (63).

2. Remove front bearing nut (77) and washer (76).

3. Remove front bearing inner race (75) and retaining washer (74). Bearing and outer race need not be removed unless bearing is to be replaced. In that event, use a suitable driver to remove bearing from case.

4. Drive gear (71), spacer (72) and third speed

TRANSMISSION

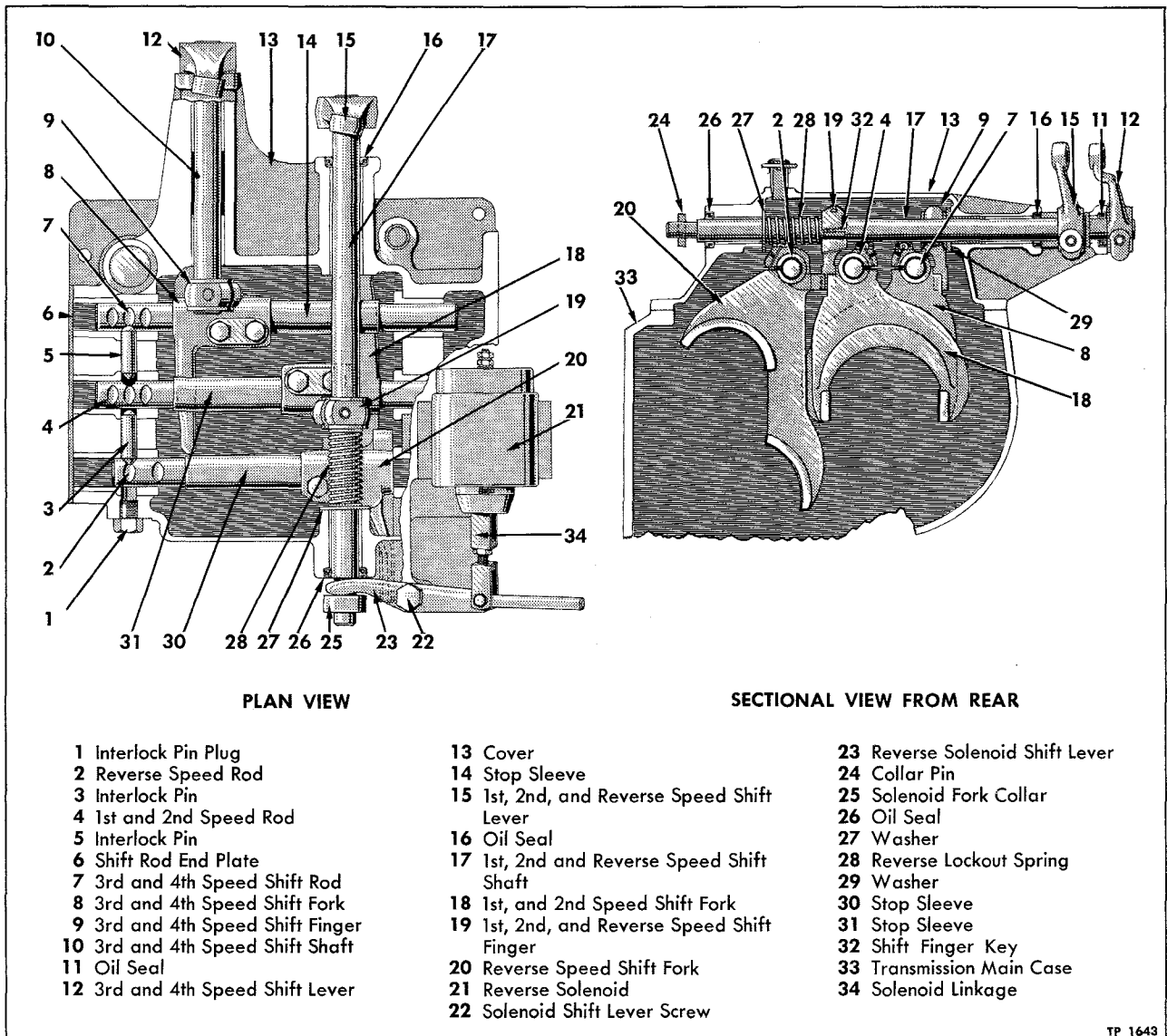


Figure 7—Sectional View of Transmission Cover

gear (69) may be pressed off countershaft.

ANGLE DRIVE GEAR AND SHAFT (Fig. 1)

1. Remove propeller shaft flange nut (10) with special wrench, (Tool No. CS 1076).

2. Remove propeller shaft flange (11) with special puller, (Tool No. CS 1062).

3. Remove bearing cap (2) with oil seal (13). Slots are provided in cap so screw driver may be used to pry it off.

4. Remove bearing retainer (19), with outer bearing (18) and inner bearing cup (20). Tapped holes are provided in retainer so that puller screws may be used to remove it. Note quantity of shims (17) used between bearing retainer and angle drive case (23). Tag shims so that original pack may

be used when reassembling. Also note quantity of shims (12) used between bearings (18 and 20). Tag these as well so that original pack may be used when reassembling.

5. Remove speedometer driven gear (22).

6. Remove bevel drive gear (28) from angle drive case.

7. Inner tapered bearing (20), speedometer drive gear (21), spacer (24) and straight bearing (26) may be stripped off shaft.

8. Bearing (26) outer race may be removed from case after snap ring (25) has been removed.

TRANSMISSION MAIN CASE COVER

(Refer to Fig. 7)

1. Remove shift rod end plate (6).

TRANSMISSION

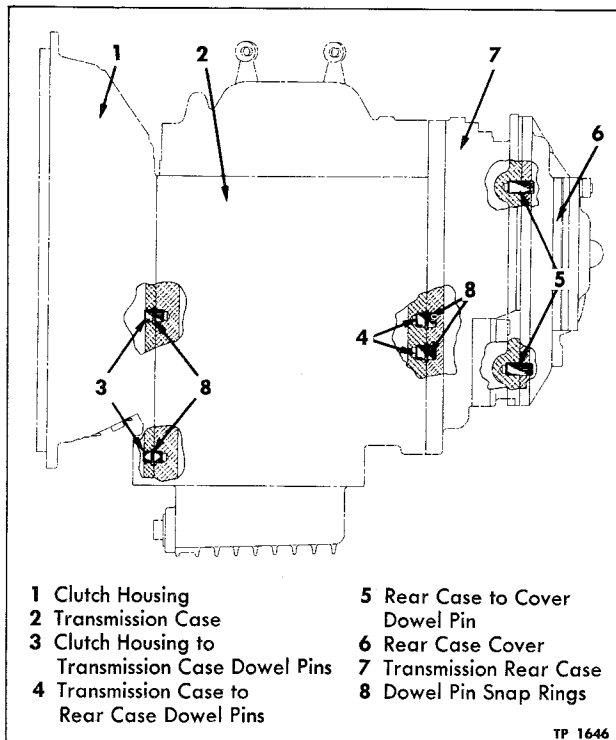


Figure 8—Transmission Case Dowel Pins

2. Remove shift fork clamp screws.
3. Remove shift rods (2, 4, and 7) from cover, stripping off forks (20, 18, and 8) and stop sleeves (30, 31, and 14) as rods are removed.
4. Remove plug (1) from cover (13) and strike cover sharply on block of wood to remove interlock pins (3 and 5).
5. Remove clamp screws from third and fourth speed shift finger (9) and remove finger from shaft (10). Finger is held to shaft with key.
6. Shaft (10) with lever (12) may then be removed from cover.
7. Remove pin (24) from first, second and reverse shaft (17) and remove collar (25).
8. Remove clamp screw from first, second and reverse shift finger (19).
9. Remove shaft (17) with lever (15) from cover, stripping off reverse spring (28) washers (27 and 29) and finger (19). Finger is held to shaft with key.
10. Solenoid shift lever (23) may be removed from cover by removing lever screw (22).

CLEANING AND INSPECTION

Clean all parts carefully in gasoline or suitable cleaning fluid and blow dry with compressed air.

All bearings should be cleaned thoroughly. After bearing assemblies have been soaked in cleaning fluid, tap them sharply on a block of

wood to dislodge any solid particles. Slush them again in cleaning fluid and blow dry with air. Do not spin the bearings with the air - revolve them slowly in races with fingers as air is directed at right angles to the balls or rollers. Examine races and bearings for pits and scores, then oil each assembly thoroughly with clean engine oil.

Individual needle bearing rollers which were removed from main shaft gears should be thoroughly washed and inspected. Replace those bearing rollers which show signs of scores or pits. (There are 138 rollers to each gear).

Examine teeth on all gears carefully for nicks and worn spots. Do not take chances with gears which are appreciably nicked or scored. Small nicks may be carefully removed with a "slip-stone" or hone.

Clean interior of main case thoroughly. Remove magnetic drain plug and clean all particles of metal from magnet. Blow out all oil passages with compressed air.

TRANSMISSION CASES AND DOWEL PINS

Clutch housing and transmission angle drive case are held in proper alignment with transmission main case by dowel pins (fig. 8). Two dowels (3) are used at front of main case and two (4) are used at rear of the main case. Angle drive case cover (6) which supports mainshaft rear bearing is also dowelled onto angle drive case.

In the original assembly the transmission serial number appearing on main case name plate is also stamped on angle drive case and cover. It is of utmost importance when assembling transmission that transmission cases are not interchanged with corresponding parts from other transmissions. ALWAYS MATCH CASES BY REFERRING TO SERIAL NUMBER.

SERVICE INFORMATION

Transmission main cases, angle drive cases and covers and clutch housings furnished for replacement are standard production parts. Oversize dowel pins are available and must be used to overcome any possible misalignment of dowel pin holes when a new transmission main case, angle drive case, cover, or clutch housing is being assembled with original parts or vice versa. Before installing oversize dowel pins, it will be necessary to enlarge and ream existing holes with parts bolted together in correct relationship.

MAIN CASE TO ANGLE DRIVE CASE OVERSIZE DOWEL INSTALLATION

Accomplish the following operations when a new angle drive case is to be installed on original main case or vice versa.

TRANSMISSION

1. Install mainshaft center bearing retainer in counterbore at rear of main case. With angle drive case attaching studs in place, place angle drive case on main case and install stud nuts. Tighten stud nuts evenly and firmly to draw the cases together. Mainshaft center bearing retainer will act as a pilot to assure correct position of angle drive case on main case.

2. Using a drill slightly smaller than oversize dowel pin diameter, enlarge the dowel pin holes. Then ream dowel pin holes to size given in "Specifications" at end of this section.

3. Remove stud nuts and separate the two cases; then add counterbore in angle drive case to accommodate oversize dowel pin snap rings (8, fig. 8).

4. Press or drive oversize dowel pins into holes in main case with snap rings contacting surface of case.

ANGLE DRIVE CASE COVER INSTALLATION
(Fig. 1)

Accomplish the following operations in the event that new angle drive case is to be installed with original angle drive case cover or vice versa. Perform operations which follow with transmission drive gear and mainshaft installed in main case and the angle drive case assembled on main case.

1. Press mainshaft rear bearings (30 and 33) into retainer (31) then bolt bearing and retainer assembly and cap (36) onto angle drive case cover.

2. Install angle drive case cover on angle drive case, guiding rear bearing over rear end of mainshaft to locate cover on case. Strike angle drive case cover with soft faced hammer to seat cover against angle drive case then install stud nuts finger tight. Rotate mainshaft to insure positive alignment of cover with mainshaft, then tighten cover retaining nuts.

3. Using a drill slightly smaller than standard dowel pin diameter (refer to "Specifications") drill new dowel pin holes through pin boss in cover and into angle drive case to depth of at least 1 inch, being careful to avoid original holes.

4. Line ream new holes to .6525 to .6550 inch then remove cover and enlarge holes in cover to .6565 to .6570 inch.

5. Remove angle drive case cover and press or drive oversize dowel pins into new holes in angle drive case.

CLUTCH HOUSING (Fig. 1)

If clutch housing is replaced with new part, ream dowel pin holes in new part to size listed in "Specifications" at end of this section, using bearing cap (86) installed on main case as a pilot for locating clutch housing.

TRANSMISSION SUBASSEMBLY BUILD-UP

Procedures as outlined in following paragraphs should be followed in order to assemble transmission with minimum time and effort.

ASSEMBLING COUNTERSHAFT & GEARS
(Fig. 1)

1. Press third speed countershaft gear (69) on shaft. Make certain that both keys are in position and keyways are free from burrs.

2. Place spacer (72) and keys (73) in position and press drive gear (71) into place.

3. Install drive gear retaining washer (74) with recessed edge towards bearing (75).

4. Install front bearing inner race (75), retaining washer (76) and nut (77). Tighten nut securely and install cotter pin.

5. Install front bearing (75) into case if it has been removed.

6. Install sliding clutch (63) over countershaft clutch gear (62). Do not install first speed gear (61) at this time.

MAINSHAFT AND DRIVE GEAR ASSEMBLY
(Fig. 1)

1. Place mainshaft in vise with rear end of shaft down (vise should be equipped with "soft" jaws).

2. Make sure second speed gear (101) is thoroughly clean especially on inside diameter then apply a coat of heavy gear oil. Place gear over mainshaft in position shown in figure 1.

3. Install 69 roller bearings (107) in hub of gear. Install bearing spacer (108) and push bearings and spacer in position. Then install top row of roller bearings.

4. Install third speed gear thrust collar (106) and install third speed gear (97) and bearings (94) in same manner as second speed gear. There are 69 roller bearings used in each row.

5. Install third and fourth speed clutch gear (93) over splines of main shaft. Install sliding clutch (78) over gear (93).

6. Install washer (92) and retaining nut (80) and tighten firmly.

7. Lock nut with lock washer.

8. Reverse position of shaft in vise and install first and second speed sliding clutch (103).

9. Install first gear (9) over mainshaft, inserting roller bearings (110) and spacer (111) in same manner as second and third speed gears.

10. Remove mainshaft with gears from vise.

11. Coat inner face of thrust washer (112) with grease and place in position. Grease will prevent washer from sliding out of place when assembly is lowered into case and in that manner prevent bearings from falling out when shaft is

TRANSMISSION

tilted for installation. It is also a good plan to temporarily wire the two large gears together to hold them in place while installing shaft.

12. Press bearing (83) into retainer (90), then install the assembly on main drive gear (85).

13. Install lock washer (88) and nut (87). Tighten nut securely and bend tangs of lock washer over flats of nut.

OIL PUMP (Fig. 1)

Oil pump may be readily assembled in following manner:

1. Insert hexagonal drive shaft (51) in end of countershaft (56).

2. Install gasket and oil pump housing (52) over studs and drive shaft.

3. Install drive gear (50) in housing, with drive bushing end of gear over drive shaft.

4. Press driven gear shaft (46) into cover (44) if it has been removed.

5. Assemble driven gear (48) over shaft (46).

6. Fill cover and housing with lubricant and assemble cover with gasket to housing.

7. Install nuts with lock washers and tighten securely.

8. Fill pressure relief valve hole with lubricant and rotate drive shaft (51) in proper direction while filling until all passages are filled with lubricant, and air is displaced. Unless oil pump is filled with lubricant, it may not pick up when first started, thereby chances of damage to transmission through lack of lubricant are increased.

9. Install pressure relief valve ball (39) spring (40) and plug (41).

10. Lock plug with lockwire.

ANGLE DRIVE GEAR AND SHAFT (Fig. 1)

1. Install drive gear straight roller bearing (26) on shaft. Be sure bearing seats firmly against gear.

2. Install spacer (24), speedometer drive gear (21), inner tapered roller bearing cone (20), spacer (15) and original shim pack (12).

3. Install bearing cups (18 and 20) in retainer (19). Be sure cups are firmly seated against shoulder of retainer.

4. Place retainer with bearing cups over inner tapered bearing cone (20) and install outer tapered bearing cone (18).

5. Install propeller shaft flange (11) and nut. Tighten nut securely.

6. Correct bearing adjustment will allow retainer (19) to turn freely but not spin. Increase or decrease shim pack (12), between bearing cones, as necessary to provide correct bearing adjustment.

7. Remove nut (10), propeller shaft flange (11) and retainer (19) with outer bearing (18). Protect shim pack (12) so it will not be disturbed until

assembled in case.

8. Install straight roller bearing outer race (26) and snap ring (25) in angle drive case if they have been removed.

9. Place bevel gear and shaft (28) in position in angle drive case (23) and install retainer (19) with original shim pack (17) and outer bearing (18). Do not install bearing cap (2).

10. Install propeller shaft flange (11) and tighten nut (10) securely.

TRANSMISSION MAIN CASE COVER

(Refer to Fig. 7)

1. Install first, second and reverse shaft (17) and lever (15) into cover (13), assembling shift finger key, shift finger (19), finger clamp screw, washer (29), reverse lock-out spring (28) and washer (27) as shaft is moved into position. Refer to figure 7 for position and relation of parts.

2. Install solenoid shift lever collar (25), and pin (24) in end of shaft.

3. Install third and fourth speed shift shaft (10) and lever (12) into cover and assemble finger key, shift finger (9) and clamp screw.

4. Insert third and fourth speed rod poppet spring, plunger and poppet in cover (13). Third and fourth rod is upper rod in figure 7, or right-hand rod when transmission is installed in vehicle and may be identified by three poppet notches closely spaced with recesses for fork clamp screws nearer poppet notches.

5. Insert 3rd and 4th speed rod (7) into cover (13) assembling spacer (14) and fork (8) as shown in figure 7, as rod is moved into position.

6. Install fork clamp screws and tighten securely.

7. Shift 3rd and 4th speed rod into neutral, install interlock pin (5) moving it down to rod (7).

8. Insert 1st and 2nd speed rod poppet spring, plunger and poppet in cover (13). First and 2nd rod is center rod and may be identified by three poppet notches closely spaced with recesses for fork clamp screws farther away from poppet notches.

9. Insert 1st and 2nd rod (4) into cover assembling fork (18) and spacer (31) as shown in figure 7 as rod is moved into position.

10. Install fork clamp screw and tighten securely.

11. Shift 1st and 2nd speed rod into neutral, install interlock pin (3) and move it down to rod (4).

12. Insert reverse rod poppet spring, plunger and poppet into cover. Reverse rod is bottom or left-hand rod and may be identified by having only two poppet notches.

13. Insert reverse rod (2) into cover assembling fork (20) and spacer (30), as shown in figure 7, as rod is moved into position.

TRANSMISSION

14. Install fork clamp screw and tighten securely.
15. Install interlock pin plug (1) in cover.
16. Install shift rod end cover gasket and cover (6).
17. Install solenoid (21) and shift lever (23) if they have been removed.
18. Install cover assembly on transmission, and adjust solenoid linkage.

TRANSMISSION ASSEMBLY

Accomplish operations which follow in sequence given, referring to figure 1, 2, & 7 for position of parts.

COUNTERSHAFT INSTALLATION

1. Place countershaft and gear assembly into case, tilt front end upward and lower rear end into case, inserting rear end through rear bearing hole in case far enough to permit front end to be inserted into front bearing (75).
2. Install first speed gear (61) on countershaft by inserting gear through rear bearing hole in case.
3. Install thrust washer (59), recessed edge towards bearing (53).
4. Press rear bearing (53), into retainer (58). Be sure retainer dowel pin is in place, then install bearing and retainer, being careful to align notch in retainer with dowel pin in case.
5. Install inner lock nut (57) and tighten securely.
6. Install lock washer (55) and outer nut (54). Tighten nut and lock both nuts by bending lips of washer over flats of nuts.

REVERSE IDLER GEAR INSTALLATION

Refer to figure 2 and note position and width of spacers installed, at ends and in between roller bearings. Install reverse idler shaft in following manner:

1. Drive shaft into case just far enough to install thrust washer, driven gear, bearings and spacers. Make sure that oil passages in shaft are clean and that plug in end of shaft is in place.
2. As shaft is driven into case, install remaining parts. Front thrust washer fits in notch in case.
3. After shaft is driven into case, tongue on outer end of shaft must be in vertical position, to register with recess in angle drive case.

MAINSHAFT AND MAIN DRIVE GEAR INSTALLATION

1. Tilt front end of mainshaft and gears assembly upward and lower rear end into transmission case and out through center bearing hole in case.

2. Place pilot bearing (81) on front end of mainshaft.

3. Using a new gasket (82) under retainer flange, install main drive gear and bearing assembly in case. Holes through retainer flange must be aligned with tapped holes in case. Also be sure gasket does not obstruct oil return passage.

4. Install new oil seal (84) in main drive gear bearing cap (86) and replace cap using same thickness of shims (89) as was removed at disassembly.

NOTE: Outer race of bearing (83) must be held tight by bearing cap (86). The thickness of shims (89) should be .002 inch less than space existing between bearing cap (86) and retainer flange when measured with a feeler gauge.

5. Insert main drive gear (85) and bearing (83) assembly into place and while working main drive gear bearing retainer into case, hold mainshaft in alignment so that pilot bearing (81) will enter pocket of main drive gear. In order to facilitate assembly of main drive gear, one person should hold mainshaft in alignment, while other is installing drive gear and bearing.

6. Remove thrust washer (112) at rear end of mainshaft and install center bearing retainer (49).

NOTE: This bearing retainer is located on case with one dowel driven into case. Dowel fits in a milled recess in retainer. The other slots or recesses in retainer are for the purpose of removing part.

7. Reinstall thrust washer (112), recessed edge towards bearings, and press center bearing (47) into place.

8. Install bevel pinion spacer (45) over rear end of mainshaft. Spacer is available in three sizes. See "Specifications" at end of this section.

9. Replace bevel pinion keys (113) and install bevel pinion (43).

ANGLE DRIVE (Fig. 1)

1. Angle drive case (23) is held to main case (79) by studs. Cases are located and held in alignment by dowel pins held in place by snap rings. Install new gasket and assemble angle drive case, with bevel gear and shaft, to main case. Make sure that pinion (43) and gear (28) teeth are matched as marked, that dowel pins are in place and that milled end of reverse idler shaft fits into milled slot in case.

NOTE: In the event new angle drive case or main case is being installed, ream dowel pin holes in new part to size shown in "Specifications" at end of this section.

TRANSMISSION

ANGLE DRIVE CASE COVER (Fig. 1)

1. Install angle drive case cover (27) using new gasket. Be sure dowel pins are in place. Draw studs up evenly and securely.

NOTE: Be sure dowel pins are in good condition.

MAINSHAFT REAR BEARING (Fig. 1)

Mainshaft Rear Bearing Adjustment (Fig. 1)

Correct adjustment of mainshaft rear bearing is obtained in following manner:

1. With bearing retainer (31) removed from transmission, install bearing (30 and 33) and cups in retainer.
2. Assemble bearing cap (36) with original shims (37). Attach cap to retainer with suitable bolts.
3. Increase or decrease shims (37) between cap (36) and retainer (31) until retainer will turn freely on bearings but will not spin.
4. Disassemble and protect shims selected for use at reassembly.

Installing Mainshaft Rear Bearing

1. Install mainshaft rear bearing spacer (29).
2. Install rear bearing retainer (31) with inner bearing cup. Do not install shims (38) between retainer and angle drive case cover (27).
3. Install bearing cones (30 and 33), lock washer (34) and nut (35). Draw nut up tightly.
4. Install puller screws in tapped holes in retainer (31).
5. While holding inner rear bearing (30) tight against its cup, adjust puller screws in retainer (31) until mainshaft and countershaft gears line up.
6. Measure space between retainer (31) and cover (27) with feeler gauge and select proper thickness of shims (38). If this thickness becomes greater than .035 inch, remove pinion (43) and replace spacer (45) with one of sufficient thickness to bring shim pack thickness to less than .030 inch.
7. Remove retainer (31) and reassemble, installing shims selected.
8. Install outer bearing cup (33) and cap (36) using shims (37) between cap and retainer as previously determined when bearing adjustment was made.
9. Check alignment of gears again.

ANGLE DRIVE GEAR BACKLASH (Figs. 1 and 9)

1. With transmission completely assembled with the exception of shims (17) between drive gear outer bearing retainer (19) and angle drive case (23) also bearing cap (2) not assembled, install puller screws in bearing retainer (19) and adjust backlash to dimensions shown on gears. If

backlash dimensions on gears are not legible, adjust to .008 - .010 inch. See backlash sketch in bottom corner of figure 9.

2. Measure space between retainer (19) and angle drive case (23) with feeler gauge.

3. Select proper shim thickness and install shims, assembling retainer, bearing (18) cap (2) with new oil seal (13), flange (11) and nut (10).

4. Tighten flange nut and cap stud nuts (14) securely.

5. Check backlash in gears again and correct if necessary by adding or removing shims (17).

ANGLE DRIVE GEAR TOOTH CONTACT (Figs. 1 and 9)

1. To check for proper tooth contact paint several teeth on pinion (43) with ground red lead mixed with a few drops of engine oil. Rotate mainshaft by hand in same direction as when operating in forward speed, applying tension at propeller shaft flange at same time. Gears may be seen through filler hole in top of angle drive case (23).

2. Tooth contact impression should start at toe of tooth and extend back about 80% of tooth length toward heel on drive side of tooth. Contact should be distributed evenly over flank and face of tooth, indicating center of contact on pitch line. Refer to diagrams "A" and "B" in figure 9.

3. If tooth contact is too far out on tooth (diagram "C" figure 9), reduce shim thickness at (17) between bearing retainer (19) and angle drive case (23) moving gear (28) towards pinion (43). Restore backlash by adding shims at (38) between bearing retainer (31) and angle drive case cover (27).

4. If tooth contact extends back from toe appreciably less than 80% of tooth length (diagram "D" figure 9), move gear (28) away from pinion (43) by adding shims at (17). Restore backlash by reducing shims at (38).

5. If contact is low on flank of tooth (see diagram "E" figure 9) move pinion (43) away from gear (28) by reducing shims at (38). Restore backlash by adding shims at (17).

6. If contact is high on face of tooth (diagram "F" figure 9), move pinion (43) towards gear (28) by adding shims at (38). Restore backlash by reducing shims at (17).

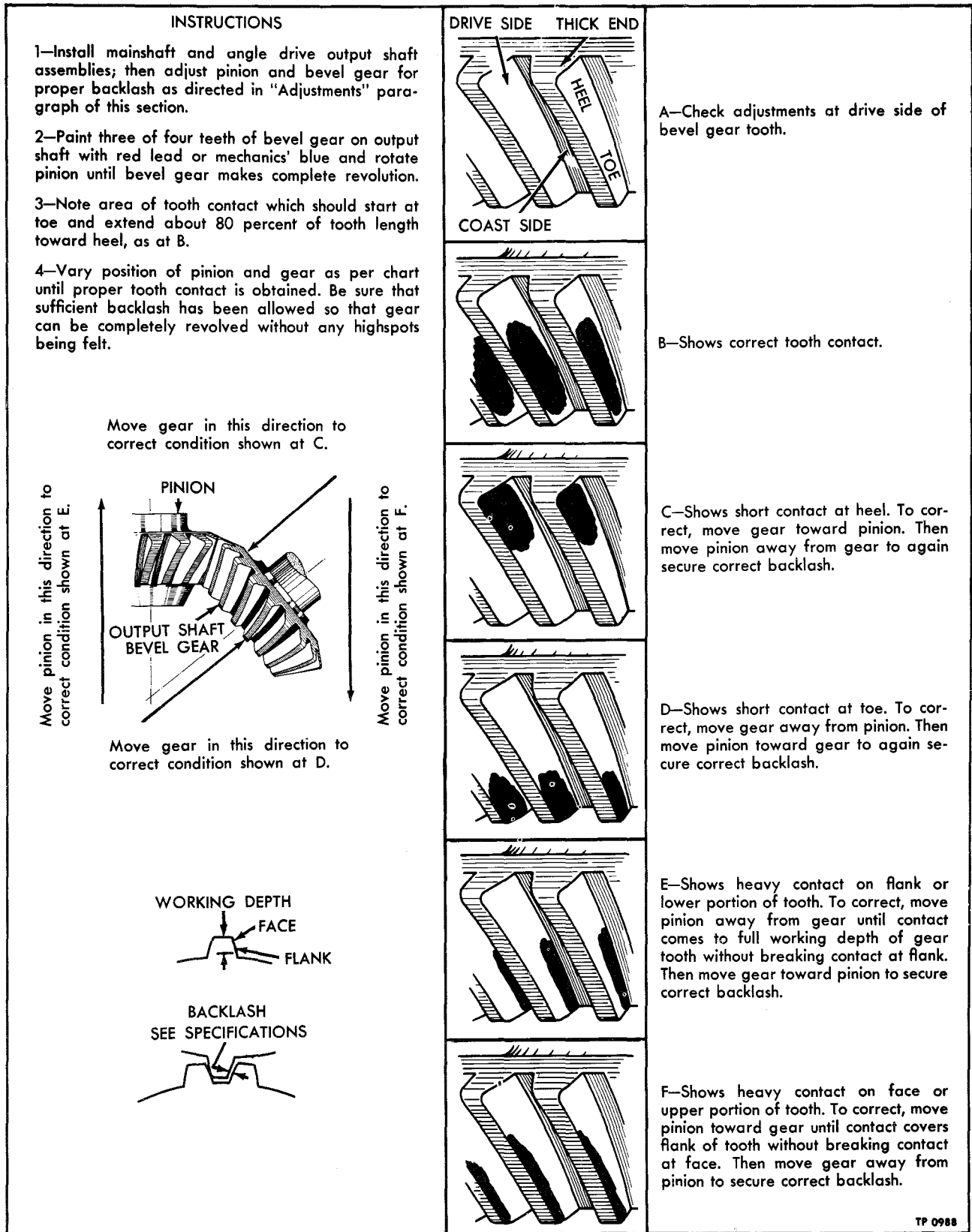
OIL PUMP INSTALLATION

1. Using new oil pump gasket, install pump assembly on transmission, guiding drive shaft (51) into socket at rear of countershaft (56).

TRANSMISSION COVER INSTALLATION

1. Place levers (105 and 5) in neutral and move clutches (78, 193, 63 and 66) to neutral position.

TRANSMISSION



TP 0988

Figure 9—Angle Drive Gear Tooth Contact Chart

TRANSMISSION SPECIFICATIONS

2. With new cover gasket in place, lower cover assembly onto transmission case so that forks enter grooves in clutches.

3. Bolt cover in place. Install reverse solenoid assembly and lever (fig. 5) on transmission cover, and adjust solenoid linkage.

Transmission Specifications

SPICER MODEL NUMBER 7141-A
Speeds Four Forward - One Reverse
Mounting Unit
Gear Selection Manual, Remote Control

GEAR RATIOS

Spicer Model	7141-A
Angle Drive Gears	1.00 to 1
First Speed	3.86 to 1
Second Speed	2.50 to 1
Third Speed	1.50 to 1
Fourth Speed (Direct)	1.00 to 1
Reverse	3.29 to 1

GEAR BACKLASH

Angle Drive Gears	0.008" - 0.010"
Mainshaft and Countershaft Gears	0.006" - 0.008"
Sliding Clutches and Clutch Gears	0.004" - 0.007"
Oil Pump Gears	0.006" - 0.008"

MAINSHAFT GEAR BEARING ROLLERS

Number of rollers per gear	138
Length	0.655" - 0.675"
Lapped Diameter	0.12500" - 0.12525"

BEARING ADJUSTMENTS

Angle Drive Gear Tapered Bearing
- See Instructions

SHIM THICKNESS AVAILABLE

Main Drive Gear Bearing Cap	0.003" - 0.010"
Mainshaft Rear Bearing Retainer	0.010" - 0.031"
Mainshaft Rear Bearing Cap	0.003" - 0.010"
Angle Drive Gear Bearing	
Cone	0.003" - 0.010" - 0.030"
Angle Drive Gear Bearing	
Retainer	0.003" - 0.010" - 0.031"

SPACER THICKNESS

Bevel Pinion - Front	
(Available in 3 sizes)	0.230" - 0.245" - 0.260"
Bevel Pinion - Rear	0.938" - 0.948"
Angle Drive Gear Bearing Cone	0.373" - 0.377"

THRUST WASHER THICKNESS

Mainshaft 1st Speed Gear	0.262" - 0.266"
Countershaft 1st Speed Gear	0.245" - 0.249"
Reverse Gear - Front	0.182" - 0.187"
Reverse Gear - Rear	0.185" - 0.186"

COUNTERSHAFT 1ST SPEED GEAR BUSHING

Inside Diameter (As Serviced)	2.346" - 2.349"
Inside Diameter (In Place)	
Grind to	2.3595" - 2.3605"

OIL PUMP GEARS

Width	0.622" - 0.623"
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OIL PUMP DRIVE GEAR SHOULDER

Outside Diameter	0.8725" - 0.8755"
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**OIL PUMP DRIVE GEAR SHOULDER
BORE IN COVER AND HOUSING**

Inside Diameter	0.8745" - 0.8755"
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OIL PUMP DRIVEN GEAR BUSHING

Length	0.610" - 0.620"
Burnish to	0.4990" - 0.5005"
Bushing to Shaft Clearance	0.001" - 0.0035"

PRESSURE RELIEF VALVE SPRING

Free Length	2-7/16"
Pressure @ 2"	3 lbs. 6-1/2 oz. 3 lbs. 9-1/2 oz.

REVERSE SHIFT LOCK SPRING

Free Length	5-1/16"
Lbs. Pressure @ 1-3/4"	38 - 42

SERVICE DOWEL PINS AND HOLES

Clutch Housing to Main Case	
Pin Diameter	0.8110" - 0.8120"
Hole Dia. in Both Pieces	0.8070" - 0.8095"

Main Case to Angle Drive Case	
Pin Diameter	0.8110" - 0.8120"
Hole in Both Pieces	0.8070" - 0.8095"

Angle Drive Case to Angle Drive Case Cover	
Pin Diameter	0.6555" - 0.6560"
Hole Diameter in Angle	
Drive Case	0.6525" - 0.6550"
Hole Diameter in Angle	
Drive Case Cover	0.6565" - 0.6570"

TORQUE WRENCH SPECIFICATIONS (Ft. Lbs.)

Companion Flange Nut	500
Mainshaft Nut	650

Propeller Shaft

Propeller shaft, used to transmit power from transmission to differential, is tubular type, equipped with heavy duty needle bearing-type universal joints.

Flange yoke, at slip joint end, is bolted to transmission companion flange (fig. 1). The shaft is splined to slip yoke and retained by a steel dust cap, which screws onto slip yoke (fig. 4).

Flange yoke, at fixed joint end, is bolted to companion flange at differential. Propeller shaft is welded to end yoke.

Slip joint, at transmission end of shaft, compensates for variations in distance between transmission and differential. These variations are brought about by the rise and fall of the rear axle as the vehicle passes over uneven ground. Slip joint also facilitates removal of transmission or power plant.

PROPELLER SHAFT REMOVAL

If propeller shaft is to be removed, with transmission in place, proceed as follows:

IMPORTANT: Yokes on joints must be exactly aligned at assembly. Before disconnecting slip joint, follow instructions under "Joint Removal," later in this section.

1. Remove lock wires, nuts, and bolt washers, which attach propeller shaft companion flange to companion flange at differential.

2. Disconnect slip joint. Make sure joint parts are properly marked for alignment. Refer to "Joint Removal," later in this section, for instructions.

3. Remove hand brake shoe assembly. Refer to "HAND BRAKE" in BRAKES (SEC. 4) for instructions.

4. Remove nuts and lock washers holding hand brake drum and oil shield to transmission companion flange (fig. 1).

5. Remove hand brake oil shield through hole in engine bulkhead.

6. Remove lock wire, nuts, and bolt washers holding propeller shaft companion flange to transmission companion flange (fig. 1).

7. Remove slip joint through hole in engine bulkhead.

PROPELLER SHAFT DISASSEMBLY

JOINT REMOVAL

Slip yoke and shaft are marked with arrows, to insure correct alignment at assembly. Make sure arrows are clearly discernible, before disconnecting slip joint. If arrows are not visible,

mark yoke and shaft distinctly; then unscrew dust cap from slip yoke. Pull shaft from slip yoke.

Stub yoke at fixed joint is integral with shaft; therefore, replacement of yoke necessitates replacement of tube assembly, consisting of stub shaft, stub yoke, and tube.

JOINT DISASSEMBLY (Fig. 2)

1. Bend lock straps free from bearing cap screws. Remove cap screws, lock straps, and bearing caps from yokes.

IMPORTANT: Do not permit needle bearings to drop on floor, since irreparable damage may result.

2. Tap yoke lightly on one end, with plastic or rawhide hammer, to dislodge bearing at opposite end. Continue until all bearings are removed.

3. Slide journal cross into one side of yoke as far as possible. Tilt journal to clear yoke and remove.

4. Slide gaskets from journal cross. Remove pressure relief valve and lubrication fitting from

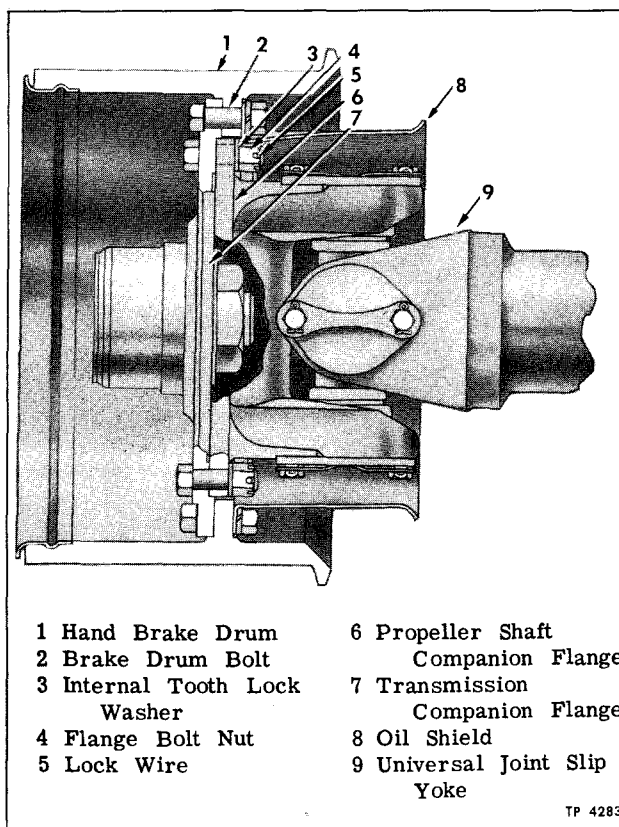


Figure 1—Propeller Shaft Installation at Transmission

PROPELLER SHAFT

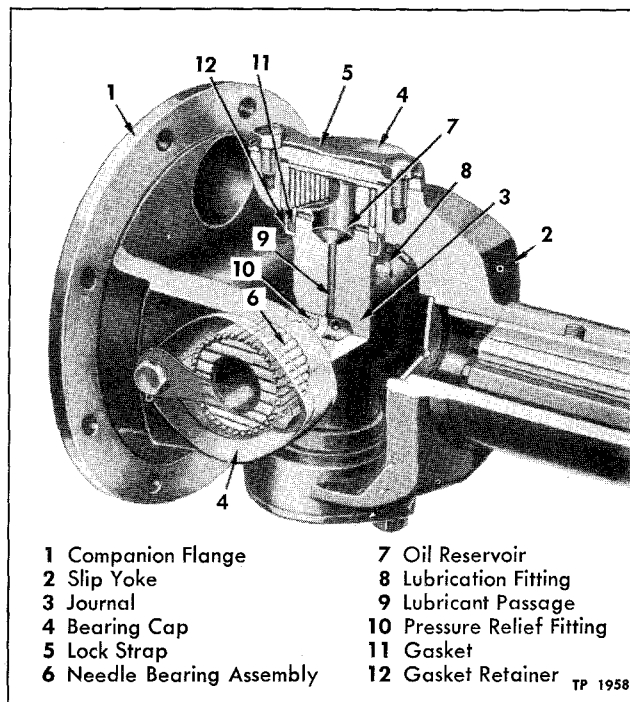


Figure 2—Cross-Section of Universal Joint

journal. Unless gasket retainers are to be replaced, do not remove retainers from journal.

CLEANING AND INSPECTION

PROPELLER SHAFT

Thoroughly clean old grease and dirt from splines of shaft; then inspect splines for wear. Refer to "Specifications," at end of this section.

Check shaft for warpage or breaks. If shaft is badly warped or broken, it should be replaced. Welding of broken shafts is not recommended, since this operation requires special facilities.

UNIVERSAL JOINT

Clean all parts with clean gasoline or other suitable cleaning fluid. Thoroughly clean all lubricant passages in journal (fig. 2), lubrication fitting and pressure relief valve. Soak needle bearing assemblies in cleaner to soften particles of hard grease. Clean bearing assemblies, using stiff brush; then blow out dirt with compressed air.

NOTE: Make sure bearing assemblies are absolutely clean, since even extremely small particles of dirt or grit can cause excessive bearing wear. Do not attempt to disassemble needle bearings.

Inspect journal bearing surfaces for roughness or needle bearing grooves. If grooves and roughness will not clean up with moderate honing, journal and bearing assembly should be replaced. Carefully inspect each bearing assembly for wear

and missing bearings (see "Specifications," at end of this section). Excessive wear is indicated if needles drop out of retainer, or if journal bearing surface shows marks of needles. If such conditions exist, needle bearing assembly should be replaced.

After needle bearing assemblies are thoroughly clean, pack with clean grease and turn on trunnion of journal to check wear. If excessive clearance is noted, further check of parts is necessary to determine which part to replace. Inspect gaskets and gasket retainers and replace if not in good condition.

SLIP JOINT

Carefully inspect yoke for cracks, wear or bent condition. Small burrs or rough spots can usually be removed with a hone. See "Specifications," at end of this section, for clearance between shaft and yoke splines. Replace, if defective or badly worn. Check expansion plug; be sure small lubrication relief hole is clean and open.

PROPELLER SHAFT ASSEMBLY

UNIVERSAL JOINT ASSEMBLY (Fig. 2)

1. Install pressure relief valve and lubrication fitting in journal; then slide new gaskets on journal.

2. Insert one trunnion of journal into yoke as far as possible from inside, and tilt until opposite trunnion clears yoke and drops into position.

IMPORTANT: When installing journal in yoke at transmission end of shaft, position journal with pressure relief valve side of journal towards shaft. This will reduce possibility of excess lubricant in journal being thrown on hand brake drum or lining.

3. Lubricate bearing (1/3 full) with lubricant specified in LUBRICATION (SEC. 13). Insert bearing assemblies from outside of yoke and tap into place with rawhide or plastic hammer. **WARNING:** Do not use steel hammer for this purpose.

4. Care should be taken to insure that joints move freely in the bearings and do not bind. If joints should be tight, change bearings around until joints are all free in assembled position.

5. Install bearing caps, new lock straps, and cap screws. Tighten cap screws firmly; then lock screws by bending lock straps against screw heads.

JOINT INSTALLATION

1. Align arrows on slip yoke and end yoke. Make sure yokes are exactly aligned, as shown in figure 3.

NOTE: If yokes are not correctly aligned, destructive vibration will occur when vehicle is in motion.

2. Place steel washer and cork washer on

PROPELLER SHAFT

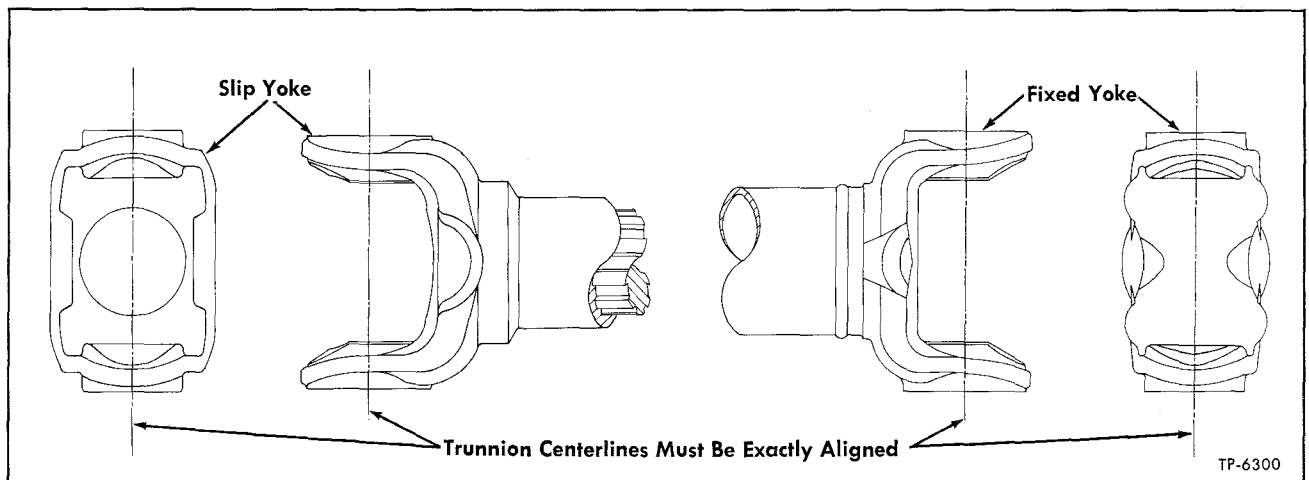


Figure 3—Yoke Alignment

shaft between splines and dust cap at slip yoke end (fig. 4). If two steel washers are used, cork washer should be positioned on shaft between them.

3. Insert slip joint end of shaft into slip yoke; then tighten dust cap by hand. Do not use wrench for this purpose as too much pressure will damage cork oil seal. NOTE: Slip joint should not be installed until propeller shaft assembly has been positioned under vehicle.

PROPELLER SHAFT INSTALLATION

1. Insert slip joint end of propeller shaft through hole in engine bulkhead.

2. Position propeller shaft companion flange to transmission companion flange; then install bolts, new bolt washers, nuts and new lock wires.

3. Insert hand brake oil shield through hole in engine bulkhead. Assemble shield and hand brake drum to transmission companion flange.

4. Install hand brake shoe assembly. Refer to "HAND BRAKE" in BRAKES (SEC. 4) for instructions.

5. Fixed joint end of propeller shaft may be inserted through clearance holes in frame and installed in slip joint.

IMPORTANT: Read instructions earlier in this section under "Joint Installation," before assembling this joint.

6. Position propeller shaft companion flange to companion flange at differential and install bolts, new bolt washers, and new lock wires.

LUBRICATION

Trunnions of universal joints are drilled and provided with lubrication fittings, through which lubricant travels to all four oil reservoirs (fig. 3) and then, through a small hole in side of each reservoir, direct to needle bearings. Pressure relief valve, in the central chamber, prevents damage to gaskets when extremely high pressure is used in forcing in lubricant. This valve also serves as an indicator to show when universal joints are completely filled with lubricant.

Needle bearings are protected against lubricant leakage and the ingress of foreign matter by gaskets.

Splines of slip joint are lubricated through lubrication fitting installed in slip yoke.

Universal joints and slip yoke splines should be lubricated periodically, as specified in LUBRICATION (SEC. 13).

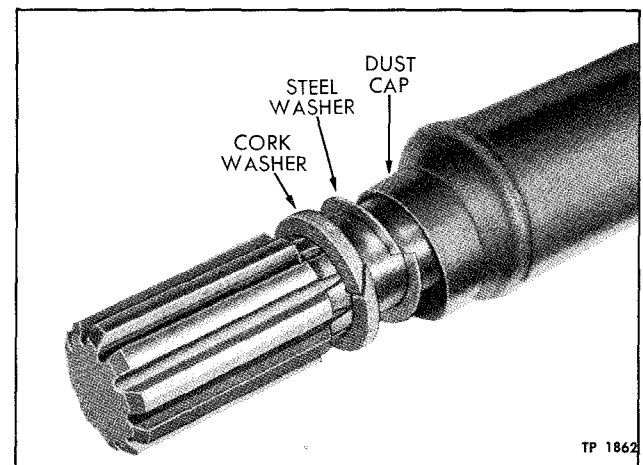


Figure 4—Propeller Shaft With Slip Joint Removed

NOTES

Wheels, Hubs, and Tires

This group includes two sections covering maintenance information on "HUBS AND BEARINGS" and "WHEELS AND TIRES."

Hubs and Bearings

Wheels and hubs are carried on two opposed tapered roller bearings as shown in figures 1 and 2. Bearings are adjustable for wear and their satisfactory operation and long life depend upon proper adjustment and correct lubrication. If bearing adjustment is too tight, bearings will overheat and wear rapidly. Loose adjustment will result in pounding, and will also contribute to steering difficulties, uneven tire wear, and inefficient brakes. Before checking or adjusting wheel bearings, always be sure brakes are fully released and do not drag. Wheel studs are installed in hub flange as shown in figures 1 and 2. Brake drums are mounted over wheel studs on outer side of hub flange and attached to hub with countersunk screws.

BEARING ADJUSTMENT

Wheel bearing adjustment should be checked carefully at each inspection period. Jack up wheels one at a time and check bearing play by using a pry bar under tires. Observe movement of brake drum in relation to brake spider or shoes. If bearings are adjusted correctly, movement of drum will be just noticeable and wheel will turn freely with no drag. If test indicates that adjustment is necessary, make adjustments as follows: (Refer to "SPECIAL TOOLS" at end of manual for bearing nut wrenches.)

FRONT WHEEL BEARINGS (Fig. 1)

1. Remove cap screws and hub cap from hub.
2. Raise lip of nut lock and remove lock nut, nut lock, and lock ring from spindle.
3. Tighten adjusting nut until wheel binds, at the same time rotating wheel to make sure all surfaces are in proper contact.
4. Back off adjusting nut $1/6$ turn, or more if necessary, making sure that wheel turns freely.
5. Replace lock ring with dowel pin in adjusting nut inserted in hole in ring. Either side of ring may be used toward adjusting nut, whichever requires the least change in position of adjusting nut to permit assembly.
6. Install nut lock and lock nut on spindle and draw nut up tight.

7. Recheck bearing adjustment, then bend lip of nut lock down against flat of lock nut. Install hub cap on hub, using new gasket between cap and hub.

REAR WHEEL BEARINGS (Fig. 2)

1. Remove axle shaft, drive plate, and drive plate ring as directed in REAR AXLE (SEC. 2). Remove outer oil seal, then remove oil seal wiper and cork assembly from end of axle housing tube.
2. Remove lock nut and lock ring from axle housing tube.
3. Tighten adjusting nut until wheel binds, at the same time rotating wheel to make sure all surfaces are in proper contact.
4. Back off adjusting nut $1/6$ turn, or more if necessary, to make sure wheel turns freely.
5. Install lock ring with dowel pin in adjusting nut inserted in hole in ring. Either side of ring may be used toward adjusting nut, whichever requires the least change in position of adjusting nut to permit assembly.
6. Install lock nut and tighten firmly, then recheck bearing adjustment.
7. Press oil seal wiper and cork assembly onto end of axle housing tube. Coat lip of outer oil seal and oil seal wiper with grease; then install oil seal, using new gasket between oil seal retainer and hub. Make sure oil seal lip is properly positioned on wiper.
8. Install axle shaft, drive plate ring, and drive plate as directed in REAR AXLE (SEC. 2).

OIL SEALS

Front and rear hubs have oil seals at inner end to prevent leakage of wheel bearing lubricant into brake drum. Inner oil seals also prevent water and dirt from entering the hubs and contaminating the wheel bearing lubricant. Oil seals at outer ends of rear hubs prevent rear axle differential lubricant from entering the hubs and mixing with the wheel bearing lubricant.

Inner seals used in both front and rear hubs are rotating, spring-loaded type. Front seals are pressed into inner end of hub and the seal lip wipes on bearing spacer (fig. 1). Rear hub inner

HUBS AND BEARINGS

seals are pressed into seal retainers which are attached to inner end of hubs with screws; seal lip wipes on a sleeve pressed onto axle housing tube (fig. 2).

Outer seals used in rear hubs are spring-loaded lip-type seals with integral retainers which fit over axle shaft drive plate studs. Oil seal lip wipes on oil seal wiper which is pressed onto outer end of axle housing tube. Wiper to tube cork gasket is cemented to inner side of wiper.

At regular inspection periods, examine all seals carefully. If there is any indication of wear, deterioration, or damage at the sealing surface, a complete new seal assembly should be installed. Also examine surface of oil seal wiper, sleeve, or bearing spacer against which seals bear. Any nicks, scratches, or rough spots on these surfaces will impair efficiency of seals.

Always spread a thin coating of grease on face of seal and on oil seal wiper, sleeve, or bearing spacer before installing hub.

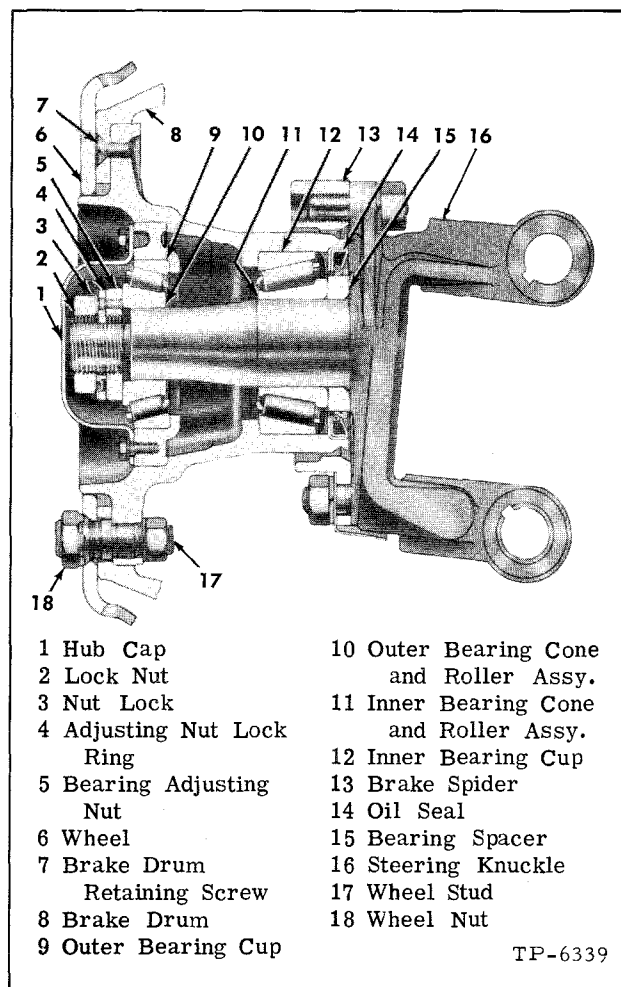


Figure 1—Front Hub, Bearings, and Oil Seal

FRONT HUB AND BEARING REMOVAL

(Figure 1)

1. Raise front end of vehicle until tires just clear floor.

2. Remove wheel stud nuts and remove wheel, then remove brake drum retaining screws and remove brake drum. Remove hub cap.

3. Raise lip of nut lock and remove lock nut, nut lock, lock ring, and adjusting nut from spindle.

4. Pull hub assembly straight off spindle, being careful not to permit outer bearing to fall out.

5. Pull inner oil seal out of hub, then lift inner bearing out of hub.

6. Perform cleaning and inspection operations outlined under "Cleaning and Inspection" later in this section. If inspection indicates the need of replacing bearing cups, they may be driven out, using a long brass drift through opposite side of hub.

REAR HUB AND BEARING REMOVAL

(Figure 2)

1. Raise rear end of vehicle until tires are just clear of floor.

2. Remove wheel stud nuts and remove wheels; then remove brake drum.

3. Remove axle shaft, drive plate, and drive plate ring as directed in REAR AXLE (SEC. 2). Remove outer oil seal and gaskets, then remove oil seal wiper from end of axle housing tube.

4. Remove lock nut, lock ring, and bearing adjusting nut from axle housing tube.

5. Pull hub assembly straight off axle housing tube. Remove outer bearing from hub.

6. Remove screws attaching oil seal retainer to hub and remove seal and retainer assembly and gasket.

7. Lift inner bearing out of hub.

8. Perform cleaning and inspection operations outlined under "Cleaning and Inspection" later in this section. If inspection indicates the need of replacing inner oil seal or bearing cups, they may be removed as follows:

9. To remove oil seal, press seal out of seal retainer. Bearing cups may be driven out, using a long brass drift through opposite side of hub.

CLEANING AND INSPECTION

CLEANING

1. Immerse bearing cone and roller assemblies in gasoline or other suitable cleaning fluid. Clean with stiff brush to remove old lubricant. Blow bearings dry with compressed air, directing air stream across bearing. Do not spin bearings while blowing them dry.

HUBS AND BEARINGS

REAR HUB AND BEARING INSTALLATION

(Figure 2)

2. Thoroughly clean all old lubricant out of inside of hub and wipe dry. Make sure all particles of gasket are removed from inner end of hub.

3. Clean lubricant off axle housing tube (rear) or spindle (front). Wipe lubricant off oil seals, using a clean cloth dampened with cleaning fluid. Do not permit cleaning fluid or grease to get on brake linings.

4. Wash all small parts such as bearing nuts, lock rings, and oil seal wipers in cleaning fluid and wipe dry.

INSPECTION

1. Inspect bearing rollers for excessive wear, chipped edges, or other damage. Slowly roll rollers around cone to detect any flat or rough spots on cone or rollers. Replace bearing assemblies if any part is damaged.

2. Examine bearing cups in hub. If cups are pitted or cracked, they must be replaced.

3. Carefully examine oil seals for signs of wear, deterioration, distortion, or damage at the sealing surfaces. Replace oil seal assembly if any of the above conditions are evident.

4. Inspect oil seal wiper, sleeve, or bearing spacer for nicks or rough spots which would cause rapid wear of seals. Replace with new parts as necessary.

5. After inspection is completed and parts replaced as necessary, lubricate bearings and inside of hub as directed in LUBRICATION (SEC. 13).

FRONT HUB AND BEARING INSTALLATION

(Figure 1)

1. If bearing cups are removed, drive or press new cups into hub with wide side of cups toward inside. Make sure cups are fully seated against shoulder in hub and are not cocked. Make sure bearings and inside of hub are lubricated as directed in LUBRICATION (SEC. 13).

2. Place inner bearing cone and roller assembly in hub; then press oil seal into hub until flush with inner end of hub. Seal wiper must point inward.

3. Coat face of oil seal and bearing spacer with grease.

4. Install hub assembly on spindle, then place outer bearing cone and roller assembly on spindle and push into hub with fingers. Install bearing adjusting nut and draw up finger-tight.

5. Install brake drum and retaining screws, then install wheel.

6. Adjust wheel bearings and complete the installation as previously directed under "Bearing Adjustment" in this section.

1. If bearing cups were removed, drive or press new cups into hub with wide side of cups toward inside. Make sure cups are fully seated against shoulder in hub and are not cocked. Make sure bearings and inside of hub are lubricated as directed in LUBRICATION (SEC. 13).

2. If inner oil seal was removed, press new oil seal assembly into seal retainer. Use extreme care when pressing oil seal into place not to distort the seal flange. Make sure inner oil seal sleeve is in place on axle housing tube.

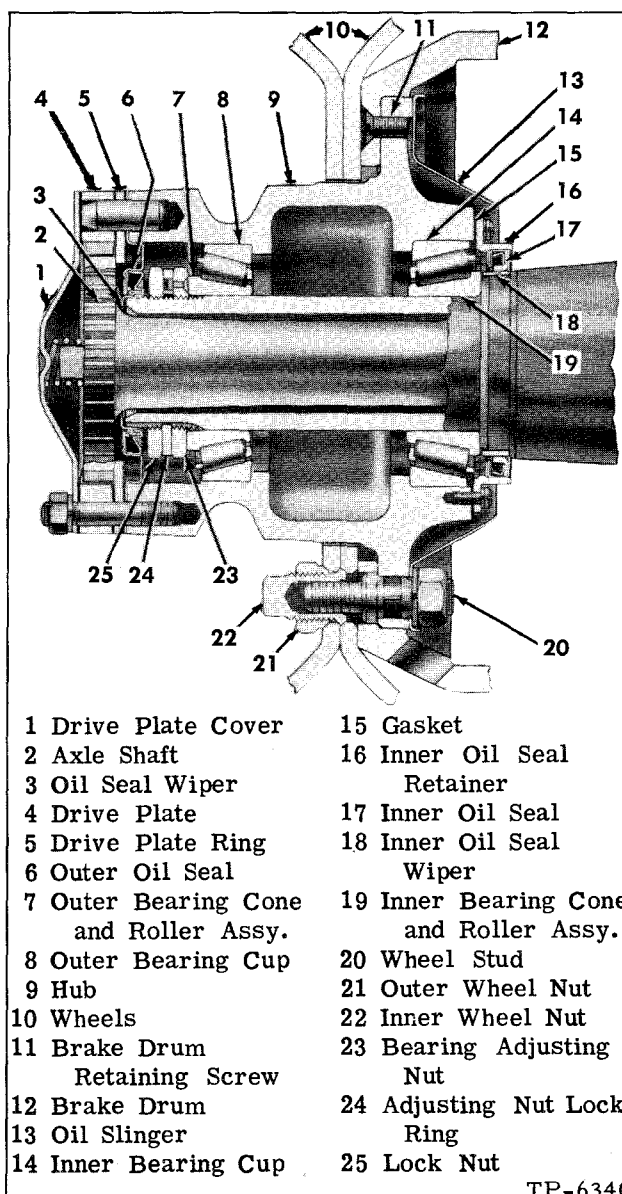


Figure 2—Rear Hub, Bearings, and Oil Seals

WHEELS AND TIRES

3. Place inner bearing cone and roller assembly in hub; then install oil seal and retainer assembly on inner end of hub, using new gasket. Draw retaining screws up evenly and firmly.

4. Coat face of oil seal and oil seal sleeve with grease.

5. Install hub assembly on axle housing tube; then place outer bearing cone and roller assem-

bly on tube and push into hub with fingers. Install adjusting nut and draw up finger-tight.

6. Install brake drum on hub and install retaining screws, then install wheels.

7. Adjust wheel bearings and complete the installation as previously directed under "Bearing Adjustment" in this section.

Wheels and Tires

WHEEL MAINTENANCE

Wheel studs and nuts on left side of vehicle all have left-hand threads. Studs and nuts on right side all have right-hand threads. Wheel stud nuts should be inspected and tightened at periodic intervals. Wheel maintenance will be considerably reduced by adherence to following procedure.

1. Before new vehicle goes into service and after each wheel removal, all wheel nuts should be thoroughly tightened. Refer to "Specifications" at end of this section for wheel nut torque specifications. See that nuts are free from grease and oil. Do not use oil on studs or nuts.

2. To tighten nuts on dual rear wheels, loosen outer nuts, then tighten inner nuts. Tighten opposite nuts alternately so that wheel will be square against hub flange. After tightening inner nuts, tighten outer nuts.

3. Re-tighten nuts daily for first 500 miles to offset setting-in of clamping surfaces.

4. Inspect wheel nuts at least every 1,000 miles thereafter. (If vehicle is subjected to severe service, this inspection should be made daily regardless of the mileage).

5. When changing wheels or tires and before assembling wheels to hubs, remove dirt, grease, and excess paint from the mating surfaces. Dual rear wheels should be positioned with valve stems 180 degrees apart.

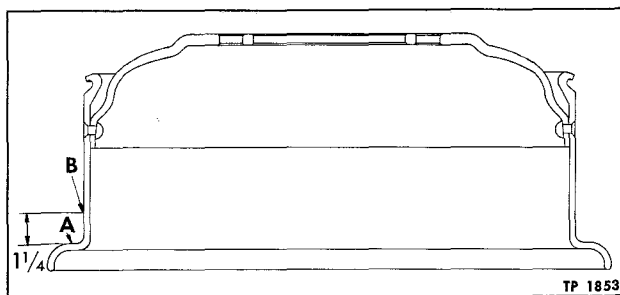


Figure 3—Wheel Checking Diagram

WHEEL INSPECTION

Do not use wheels with bent rims. The continued use of such wheels will result in excessive tire wear and, if wheel is mounted on front of vehicle, difficulty in steering vehicle will be experienced. Wheels that are thought to be distorted may be checked as follows (see fig. 3):

1. Remove wheel from vehicle and dismount tire.

2. Clean all rust, scale, dirt, and grease from rim.

3. Mount wheel securely in lathe or other suitable fixture. NOTE: Face of hub must run true, as any runout at that point will be increased from 1-1/2 to 3 times at checking points on rim.

4. Revolve wheel slowly and check at point "A" for lateral runout (wobble). This should not exceed 3/32". Check at point "B" for radial runout (out-of-round). This should not exceed 1/8" total indicator reading. Wheels that are distorted in excess of these limits should be replaced.

TIRE MAINTENANCE

One of the most important factors of economical and safe motor vehicle operation is systematic and correct tire maintenance. The tires must not only support the weight of the loaded vehicle, but they are also integral parts of the transmission and braking systems. Therefore, the tires should receive careful, systematic, and regular maintenance as do other operating units. The three major causes of tire trouble are (1) under-inflation, (2) bruises, and (3) misalignment. Tires should be checked periodically for these conditions.

INFLATION OF TIRES

Under-inflation is the greatest cause for loss of tire life expectancy. Tires should be checked frequently for this condition. The fabric, rubber, bead, contour, and size of tires used on these vehicles are designed to obtain maximum length of service under all operating conditions to which vehicles may be subjected. TIRES ARE DESIGNED TO OPERATE EFFICIENTLY ONLY ON A PRESCRIBED AMOUNT OF AIR. Unless the correct air pressure is consistently maintained,

WHEELS AND TIRES

the tires will not function as they should; consequently, safe, economical operation of the vehicle will be materially affected.

The operating air pressure recommended by the tire manufacturer is as essential to the safe and economical operation of the tire as the proper amount of oil would be to the engine or other chassis units.

A under-inflated tire runs sluggishly, heats up quickly because of the greater flexing, and is subjected to more frequent bruising. On the other hand, over-inflation may weaken the tire, causing a blow out. In addition to the deteriorating effect improperly inflated tires may have on the tire life, this condition will affect steering, riding comfort, and safe driving. **FOLLOW THE TIRE PRESSURE RECOMMENDATIONS OF THE TIRE MANUFACTURER.**

BALANCED INFLATION

The whole efficiency of the vehicle will be upset if air pressures in the tires are out of balance. Balanced inflation may be expressed as all tires on the same axle should always carry the same pressure. A difference in air pressure of the rear tires and front tires may be permissible within certain limitations; however, there should not be a difference in pressures between the right and left tires on the same axle. A five pound under-inflation in one front tire not only can destroy ease of steering, but creates steering hazards which generally point to a potential accident. An under-inflated rear tire can destroy the value of the most efficient brakes. Balance the tires for ease of steering, comfort in riding, safety in driving, as well as for minimum fuel consumption and maximum tire mileage.

PRESSURE LOSS

At periodic intervals, each tire should be gauged for pressure loss with an accurate gauge before tires are brought to correct operating pressure. The purpose of this check is to determine exact pressure losses in each tire. In other words, if at the time this check is made, a definite pressure loss is noted in any one of the tires, an inspection should be made of the tire showing the loss and cause of loss corrected. This method should definitely establish a "danger signal" on the condition of the tires. The pressure loss check should be made consistently with the same gauge, so that any element of inaccuracy in the gauge will be the same for all tires.

ROTATION OF TIRES

Tires should be interchanged at regular intervals to obtain maximum life. Change wheels without dismounting tires so direction of rotation will be reversed. The following system of inter-

changing is suggested: Right front to left rear inside or right rear outside. Left front to right rear inside or left rear outside.

If the inside tires show more wear than the outside dual tires, place front tires on inside when changing. In this case, outside dual tires can be interchanged between right- and left-hand side of vehicle.

If the outside dual tires show more wear than the inside dual tires, place front tires on outside when changing. At the same time, interchange right- and left-hand inside duals.

New tires should be installed on front wheels where they run coolest.

TIRE VALVES

The valve core is a spring-loaded check valve in the valve stem, permitting inflation or deflation of the tube. This check valve, or core, is not intended to hold the air during operation. The valve cap is provided to seal the air in the tube. When valve cap is tightened down on stem, the sealing washer inside cap is pressed tightly against top of stem, preventing air leakage. It is important, therefore, that valve caps be used.

SELECTION OF TIRES

All tires on an axle should, whenever possible, be of the same make, since differences in design and tread in some instances result in unequal tire rolling radii. When installing tires on a vehicle, all tires on each axle should have the same outside diameter within 1/4 inch. If tires do not have the same outside diameter (within 1/4 inch) excessive tread scuffing and hard steering will result. Tire diameters may be measured with a conventional tire measuring gauge.

TIRE REPLACEMENT**Removal (Fig. 4)**

1. Completely deflate tube. Place tapered end of rim tool in depression in locking ring then press down on side ring to free bead (View B, fig. 4).

2. Continue downward pressure on side ring progressively around tire until bead is free from seat (View C, fig. 4).

3. To disengage locking ring from gutter, insert rim tool in removing notch (View D, fig. 4), then press downward.

4. Insert rim tool between locking ring and side ring, then press downward to pry ring up. Move progressively around rim until locking ring is free, lift off locking and side rings (View E, fig. 4).

5. To loosen other bead, turn tire over; then drive flat blade tool between bead and flange at any point until tool contacts bead seat of rim.

WHEELS AND TIRES

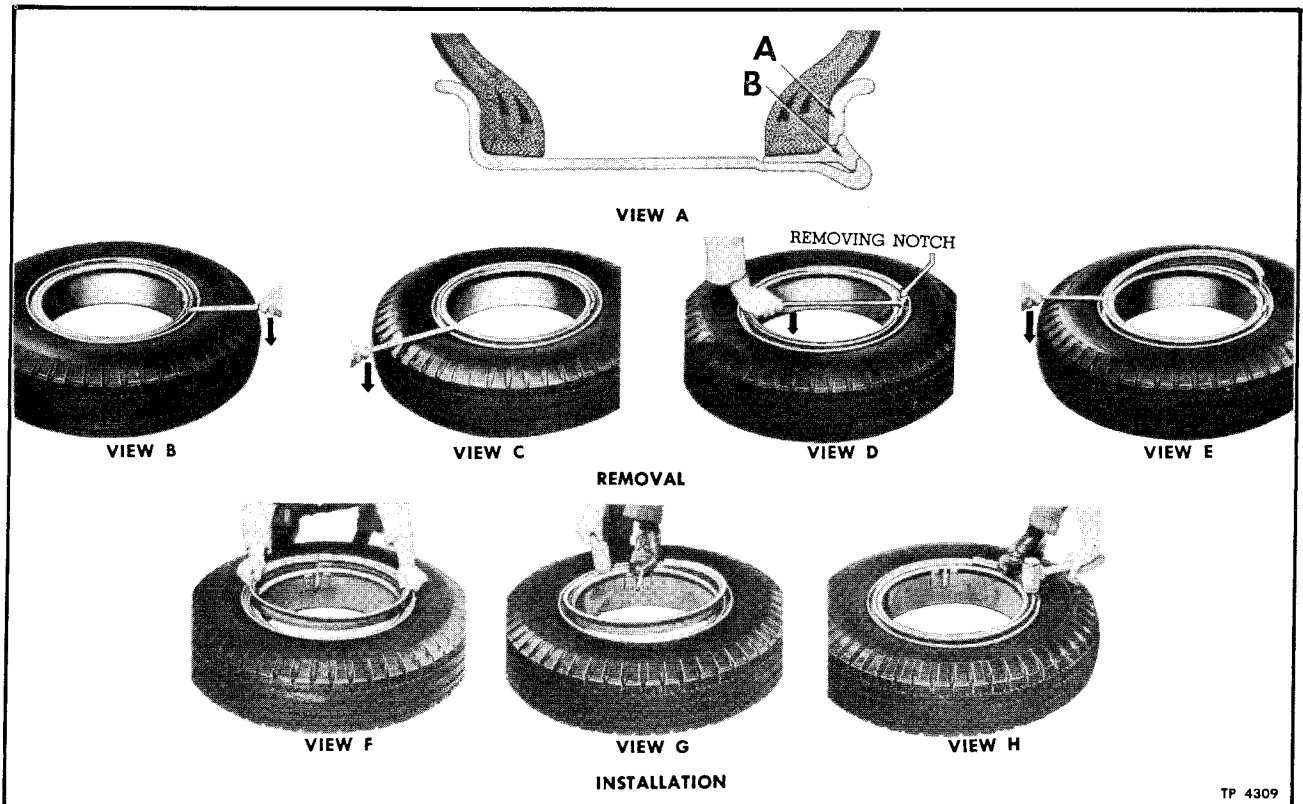


Figure 4—Tire Removal and Installation

6. Force down on tool handle, insert rim tool, then pull upward to force bead away from flange. Continue until bead is completely loosened.

Installation (Fig. 4)

NOTE: When installing synthetic tubes, coat both sides of the flap, the inner diameter of the tube, and the inside of the tire beads with a solution of neutral vegetable oil soap. Use a brush or cloth swab to apply the solution. Do not allow the solution to run down into the tire. This treatment aids tube in shaping itself during inflation without undue stretching in the rim and bead region.

1. Place rim base on floor with removable flange side up. Position tire on rim, inserting valve stem in valve slot.

2. Replace removable side ring "A" (View A,

fig. 4) on bead of tire. Side ring will be automatically centered when locking ring "B" (View A, fig. 4) is in place.

3. Position locking ring by inserting the tapered toe between side ring and bottom of tire bead (View F, fig. 4).

4. To fasten locking ring, hold ring with foot at one end of split, then hammer end of ring into place with rim mallet (View G, fig. 4).

5. Continue progressively around the rim, holding locking ring with foot and hammering until entire ring is seated (View H, fig. 4).

6. Partially inflate tire, then inspect to be sure beads are seated against rim flanges.

7. Inflate tire to full pressure, then deflate to remove wrinkles from tube. Reinflate to recommended pressure and install valve cap.

WHEEL NUT TORQUE SPECIFICATIONS

Front Wheel Nuts and Rear Wheel

Inner and Outer Nuts 350-400 ft.-lbs.

Trouble Shooting

The information in this section includes trouble symptoms which might be encountered and their probable causes. No attempt is made to outline detailed repair instructions, as these instructions are included in various sections of this Maintenance Manual.

Causes of trouble symptoms in any automotive vehicle may be varied; therefore, a hit-and-miss search would result in a tedious guessing contest. Proper

diagnosis of symptoms is an orderly process of eliminating the causes of the symptoms. An "orderly process" means to check the most probable or common cause first, then proceed with the next probable cause.

Additional publications which cover these units are as follows:

Unit	Form No.
Diesel Engine	X-5014A
Air Conditioning	X-5028

When trouble is encountered in these units always refer to the applicable publication.

The following procedures are grouped to permit a practical diagnosis of trouble symptoms. In many instances, a symptom indicating trouble in one unit may be caused by a difficulty in a closely related unit or system.

When repairs or adjustments are required, reference should be made to applicable manual section for detailed procedures.

ELECTRICAL SYSTEM TROUBLE SHOOTING

This paragraph includes only those symptoms which might occur in the starting system, battery, generator and regulator, and lighting system.

STARTER

If the engine fails to start after repeated and satisfactory operations of the starter, cause of failure cannot be attributed to the starting system, but to other functioning systems of the engine.

Starter Fails to Operate

1. Low battery.
2. Loose or broken battery or ground cables.
3. Starter solenoid contacts corroded or burned, preventing a good contact.
4. If, after making the above corrections, the starter still fails to operate, overhaul and repair or replace.

Starter Noisy

1. Loose mounting.
2. Insufficient lubrication.
3. If starter is still noisy, it is in need of an overhaul and must be repaired or replaced.

Slow Cranking Speed

1. Heavy engine oil in a cold engine.
2. Weak battery or loose cable connections.
3. Excessive resistance in circuit. Perform line voltage tests.
4. If the starter still operates slowly after making the above corrections, overhaul and repair or replace.

BATTERY

Discharged

1. Terminals may be loose or corroded.
2. Low water in cells.
3. Shorted cells.
4. Defective generator.
5. Improper regulator adjustment. Test, adjust, or replace.

Overheating

Regulator defective or in need of adjustment.

GENERATOR AND REGULATOR

Since generator and regulator functions are directly related, both units must be considered when checking trouble symptoms in generator circuit. When the ammeter shows an unsatisfactory reading, make sure ammeter is correct before making repairs on generating system.

High Charging Rate With Fully Charged Battery

1. Check ground wire from generator to regulator for damage or loose connections.
2. Clean and tighten all the terminals and connections in the generator circuit.
3. If condition still exists, either voltage regulator is in need of adjustment, or generator is in need of an overhaul.

Low or No Charging Rate With Low Battery

1. Check all wires between generator and regulator for worn insulation or other damage.
2. Loose fan belt.

3. If this does not correct the trouble, either the generator or regulator, or both, must be replaced.

Noisy Generator

1. Loose generator mounting.
2. If noise is still present, repair or replace generator.

LIGHTING SYSTEM

Reference to lighting circuit diagram will show that a single circuit from battery to gang switches is common to all lights. At gang switches, single circuit is divided into multiple circuits, each common to its particular circuit. These circuits are then taken to junction points where they are divided into individual circuits, each taken to a single light. Return path of each circuit is through ground to battery. Dividing circuits in this manner provides a convenient and logical method of locating the source of trouble. The use of a voltmeter or trouble lamp, and adherence to the following principles will aid in locating trouble in the lighting system.

1. Source of trouble common to all lights will be located in that part of the circuit common to all lights.
2. Source of trouble common to one or more — but not all — lights will be located in that part of the circuit common only to the lights affected.
3. Source of trouble at a single light will be confined to the individual circuit of the light affected.

TROUBLE SHOOTING

One Light Fails

This condition is the result of an open circuit or grounded wire between the light ground and the feed wire junction. Open circuit or grounded wire may be caused by a burned out or broken light bulb filament; poor ground at light; corroded contacts or terminals; broken wire; frayed insulation; grounded or shorted terminals; defective light switch.

Two or More Lights Fail

The cause of this condition will be located between the light switch and the individual light junction. Cause may be defective individual light switch, loose or corroded terminals, or broken wire. When two or more lights controlled by a single switch fail while others on the same switch

are satisfactory, it indicates that the defect is between junction and lights.

All Lights Fail

The cause of this condition will be located between the point where the battery ground strap attaches to the frame and the light switches

1. Discharged battery, corroded battery terminals, corroded or broken battery cable or ground strap. Check these points by cranking engine with starter. If cranking speed is normal, trouble lies between the battery and light switches.

2. Loose or corroded terminals; defective light switches; short circuit or ground at some point in system which causes fuse to burn out. The only remedy

is to methodically check the system until the fault is located and corrected.

3. A vehicle not in use for some time may possibly have all light bulb contacts corroded to the point where lights are inoperative. A remote possibility of failure is that all filaments may have been broken by shock.

Lights Give Insufficient Light

Excessive resistance in circuit or discharged battery. Check condition of battery, then look for loose or corroded terminals and contacts, and frayed insulation on wires.

Frequent Light Bulb Failure

High voltage, caused by a defective or improperly adjusted voltage regulator.

FRONT END TROUBLE SHOOTING

The symptoms which follow pertain to front wheel action trouble, generally caused by incorrect front wheel alignment, steering geometry, or steering mechanism. Therefore, all trouble symptoms which may relate to the steering of the vehicle are included.

Whenever diagnosing steering difficulties, other allied factors must be checked. A symptom indicating possible trouble in the steering system may also be evidence of deficiency in other units, i.e., front axle alignment, front spring suspension, tire inflation, wheel and tire mounting, wheel bearing adjustment, frame alignment, and brakes.

HARD STEERING

1. Improper adjustment of steering gear worm bearings, sector shaft lash, or drag link.
2. Under-inflated front tires.
3. Lack of lubrication.
4. Bent controls in steering gear linkage. Repair or replace defective parts.
5. Bent, broken, or worn front axle parts.

6. Body longitudinal member bent.

7. Front wheel misalignment.

WANDER OF LACK OF STEERING CONTROL

1. Steering gear mounting or pitman arm loose, or excessive sector gear backlash.
2. Drag link ball sockets loose.
3. Misalignment of axle or front wheel.
4. Worn parts in steering system.
5. Unequal tire pressure.
6. Unequal camber.

ROAD SHOCK TRANSMITTED TO STEERING WHEEL

1. Worn or improperly adjusted wheel bearings.
2. Excessive tire pressure.
3. Improper adjustment of drag link, worm bearings, or sector gear lash.

UNEQUAL RIGHT AND LEFT TURNING RADIUS

1. Shifting of front axle on springs.
2. Improperly adjusted steering knuckle stop screws.

FRONT WHEEL SHIMMY

1. Unequal tire pressure.
2. Broken, bent, or worn front axle parts.
3. Broken, bent, or worn steering mechanism parts.
4. Improper adjustment of toe-in and castor.
5. Unbalanced tire or wheel.
6. Improper steering gear or drag link adjustment.
7. Bent wheel or improperly mounted tire.
8. Improperly adjusted or worn bearings.

VEHICLE PULLS TO ONE SIDE

1. Incorrect toe-in.
2. Camber and castor are incorrect.
3. Defective springs.
4. Broken, bent, or worn front axle parts.
5. Improper alignment or broken body longitudinal member.
6. Incorrect axle alignment.
7. Unequal pressure in front tires.
8. Wheel bearings worn or improperly adjusted.
9. Front brake dragging on one side.

REAR AXLE TROUBLE SHOOTING

An unusual noise is usually the first indication of improper functioning of axle driving parts. Noises which seem to come from the axle may be caused by some other unit such as transmission, propeller shaft, or tires.

CONTINUOUS AXLE NOISE

1. Difficulty in the axle or unevenly worn tires.
2. To determine if noise is caused by axle or by tires, drive vehicle on soft terrain. If this stops the noise, it is being caused

by the tires and not by the axle. Inflate tires to manufacturer's recommendations or replace if necessary.

3. If noise continues on soft terrain, it is caused by worn or improperly adjusted wheel

TROUBLE SHOOTING

bearings, differential gears or bearings, or by insufficient lubricant in the differential. Add lubricant, adjust wheel bearings, adjust, repair, or replace axle differential assembly

AXLE NOISE ON DRIVE OR ON COAST ONLY

1. Differential pinion and ring gear out of adjustment or worn excessively. Adjust, repair, or replace differential assembly.

EXCESSIVE BACKLASH IN AXLE

1. Loose axle shaft flange cap screws or stud nuts; worn holes in flanges; worn shaft splines.
2. Differential pinion and ring gear out of adjustment or worn.

BRAKE TROUBLE SHOOTING**SLOW BRAKE APPLICATION**

1. Low line pressure. Adjust application valve.
2. Broken brake chamber diaphragm or leaking chamber.
3. Restriction in brake lines.
4. Excessive chamber push-rod travel.
5. Worn brake shoe linings.
6. Quick release or relay valve corroded.

SLOW BRAKE RELEASE

1. Quick release, relay, or application valve exhaust port restricted.
2. Quick release, relay, or application valve corroded.
3. Restricted lines prevent quick release of air pressure.
4. Intake valve in application valve improperly seated.
5. Brake camshaft binding.
6. Brake shoe rollers sticking or shoe frozen at anchor pin.
7. Lack of lubrication.

LOW AIR PRESSURE

1. Leak in fittings or air lines.
2. Leak at application valve intake valve.
3. Governor is defective or improperly adjusted.
4. Defective compressor unloading valve operation.
5. Defective compressor discharge valve operation.
6. Compressor discharge line choked with carbon.

SLOW PRESSURE BUILD-UP

1. Check all items previously listed under "Low Air Pressure."
2. Worn compressor parts necessitating complete overhaul of compressor.

RAPID LOSS OF PRESSURE WHEN ENGINE IS STOPPED

1. Air leaks in system.
2. Defective compressor discharge valve operation.

EXCESSIVE AIR PRESSURE

1. Unloading diaphragm is defective.
2. Excessive unloading valve clearance.
3. Governor improperly adjusted or defective.
4. Restriction in air line from unloading chamber to governor.

NOISY BRAKES

1. Dirty, worn, or loose brake lining, or distorted brake shoes.
2. Scored or damaged brake drums.

ONE BRAKE DRAGS

1. Improper adjustment.
2. Corroded or bent brake mechanism. Weak or broken brake shoe return spring.
3. Restricted brake line.
4. Inoperative chamber due to bent push rod.
5. Wheel bearings out of adjustment.

CLUTCH TROUBLE SHOOTING

The clutch is designed for maximum efficiency and long life, and with reasonable care, no operating difficulty should be encountered. Natural wear will occur, however, and must be compensated for by adjustment.

CLUTCH SLIPPING

1. Improper adjustment (no pedal free-travel).
2. Worn facings, grease on facings, clutch disc hub binding on clutch shaft, or insufficient spring tension.

3. Pressure plate sticking. Clearance between the driving block and the pressure plate lugs is excessive.

CLUTCH GRABBING AND CHATTERING

1. Improper operation due to poor driving practices.
2. Improper pedal free-travel adjustment.
3. Mounting bolts in engine loose.
4. Grease on facings, worn splines on clutch shaft or in disc

hub, facing loose on disc, or pressure plate scored or rough. Replace defective parts or complete clutch assembly. Inspect for worn splines on clutch shaft and replace if this condition is found.

IMPROPER RELEASE

1. Improper adjustment.
2. Pressure plate or driven disc worn, warped, or distorted.
3. Weak or broken return springs.
4. Worn release bearing.
5. Controls binding.

SPRING TROUBLE SHOOTING**HARD RIDING**

1. Vehicle overloaded or load unevenly distributed.
2. Shackle pins and bracket bolts "frozen" or broken due to insufficient lubrication.
3. Axle shifted on springs.

OVER FLEXIBLE

1. Excessive lubrication of spring leaves.
2. Spring leaf rebound clips broken.
3. Shock absorbers defective. Lack of fluid, worn or broken

parts. Keep filled to level plug or disassemble and inspect for parts failure.

EXCESSIVE NOISE

1. Worn shackle bolts and spring eye bolts or bushings.

TROUBLE SHOOTING

2. Loose spring clip nuts. If axle is shifted on springs, relocate and tighten spring clip nuts.

SPRING LEAF FAILURE

1. Overloading vehicle or driving at excessive speed over rough terrain.

2. Loose rebound clips.
3. Shackle and bracket pins frozen due to lack of lubrication.
4. Grabbing brake.

Symptoms indicating trouble in transmission is sometimes caused by another assembly, such as axle, propeller shaft, universal joint, or clutch. Therefore, before removing the transmission to locate the trouble, always check the possibility that trouble may exist in other units.

NOISY

Before beginning the actual operations to eliminate noise attributed to transmission, make sure that the noise is not coming from another unit in vehicle, such as propeller shafts or rear axle. Also bear in mind that a limited amount of the transmission gear "noise" is normal, except when unit is in direct drive. Following are some of the causes of noise.

1. Worn or damaged parts.
2. Improper or insufficient lubricant.

TRANSMISSION TROUBLE SHOOTING

3. Transmission and clutch housing out of alignment. Tighten transmission mounting bolts if not tight, otherwise determine and correct cause of misalignment.

SHIFTING DIFFICULTIES

1. Improper adjustment of clutch release linkage.
2. Binding in transmission control cover.
3. Bent or binding of control rods at guides.
4. Wrong driving practices.
5. Too heavy gear lubricant.
6. Reverse solenoid linkage out of adjustment will contribute to difficulty when shifting into reverse.

JUMPING OUT OF GEAR

1. Improper shifting of gears. Completely engage mating gears before releasing clutch. Move gearshift lever until poppet engages notch in shift rod.

2. Excessive end play due to wear in one or more of following parts: Shift forks, fork grooves in sliding clutches, thrust washers, mainshaft, countershaft, or gear bearings or bushings.

3. Broken snap rings permitting gears or shafts to move endwise.

4. Shift forks bent or loose on shift rods.

5. Loose propeller shaft companion flange nut.

6. Poppet springs weak or broken.

LUBRICANT LEAKS

1. Lubricant level too high.
2. Worn oil seal.
3. Main drive gear bearing retaining screws loose.
4. Cover plate screws loose or gaskets defective.
5. Bearing retainers loose.
6. Transmission case cracked or broken.

PROPELLER SHAFT TROUBLE SHOOTING

EXCESSIVE NOISE OR VIBRATION

1. Universal joints in need of lubrication.

2. If propeller shafts are not assembled with universal joints in the same plane, vibration will result. Check for this condition

and if found, disconnect propeller shafts and place universal joints in same plane.

3. Worn universal joint bearings or journals, or sprung propeller shaft will cause vibration and noise.

4. Any mechanical movement

has vibration periods, which do not result in noise until they tune in with some other part or unit. In this connection, loose or broken body panels, etc., should be checked as the source of noise if the above remedies do not correct the condition.

WHEELS, HUBS, AND TIRES TROUBLE SHOOTING

When localizing wheel and tire trouble symptoms, also consider various related systems such as wheel alignment, steering gear and brake system. Deficiencies in these systems or units will affect performance of wheels, tires, and hub bearings.

EXCESSIVE OR UNEVEN TIRE WEAR

1. Unequal pressure in tires.
2. Front wheel misalignment.
3. Bent wheels or damaged wheel bearings.
4. Broken, bent, or worn front axle parts.

WHEELS POUNDING

Hub bearings damaged or in need of adjustment. A bent wheel will also cause this condition.

SHIMMY

Conditions which cause wheel shimmy are listed under "Front End Trouble Shooting."

SPECIAL TOOLS

References are made to special tools in the various groups of this manual. These tools, or their equivalent, are necessary and are recommended to readily and efficiently accomplish certain service operations. The tools, however, are not supplied by GMC Truck & Coach Division. Names and addresses of Tool Vendors are given at the end of this tool list. Since these vendors are the suppliers of these tools, information regarding availability, prices, etc., should be obtained directly from them.

<u>Tool No.</u>	<u>Tool Name</u>	<u>Vendor Code</u>
REAR AXLE		
CS-1047	Bearing Puller	CS
J-2654	Slide Hammer Assembly	KM
BODY		
CS-1154	Seal and Insert Installer	CS
AIR COMPRESSOR AND GOVERNOR		
BWE-202812	Unloader and Discharge Valve Grinding Tool	BW
BWE-230197	Driver Bit for Valve Grinding Tool	BW
BWE-213606	Unloader Valve Seat Reamer	BW
BWE-230194	Discharge Valve Seat Lapping Disc	BW
BWE-221622	Discharge Valve Seat Lapping Stone	BW
BWE-221614	Discharge Valve Seat Reamer	BW
BWE-211398	Governor Upper Valve Grinding Tool	BW
BWE-221609	Governor Lower Valve Grinding Tool	BW
BWE-211397	Governor Lower Valve Seating Tool	BW
CLUTCH		
CS-1420	Clutch Lever Adjusting Tool	CS
CS-1914	Pilot Bearing Remover	CS
CS-1915-A	Clutch Aligning Arbor	CS
COOLING		
K-558	Shutter Thermostat Testing Unit	KH
CSD-1422	Fan Hub Puller	CS
SPRING SUSPENSION		
J-767	Shock Absorber End Cap Wrench (Hexagon)	KM
J-896-A	Shock Absorber Valve Installing Tool	KM
TRANSMISSION		
CS-1072	Mainshaft Rear Bearing Nut Wrench	CS
CS-1048	Bevel Pinion Puller	CS
CS-1076	Flange Nut Wrench	CS
CS-1062	Flange Puller	CS
HUBS AND BEARINGS		
CS-1109	Front Wheel Bearing Outer Nut Wrench	CS
CS-1419	Front Wheel Bearing Inner Nut Wrench	CS
CS-1417	Rear Wheel Bearing Inner and Outer Nut Wrench	CS

VENDOR NAMES AND ADDRESSES

<u>Vendor Code</u>	<u>Vendor Name</u>	<u>Address</u>
KM	Kent-Moore Organization	Detroit, Michigan
CS	Curtis & Smith Manufacturing Co.	Pottstown, Pa.
BW	Bendix-Westinghouse Automotive Air Brake Co.	Elyria, Ohio
KH	Kysor Heating Co., ...	Detroit, Michigan

SPECIAL MATERIAL

GMC Sealing and Caulking Compound is recommended for use as a sealer in general body maintenance and repair. This Compound is available at GMC zones, retail stores, and dealers, and may also be obtained from Parts Department at the factory in Pontiac, Michigan. The Compound is supplied in various container sizes, as follows:

<u>Part No.</u>	<u>Container Size</u>
2211921	1 pint can
2211922	1 quart can
2211923	1 gallon can
2211924	5 gallon can